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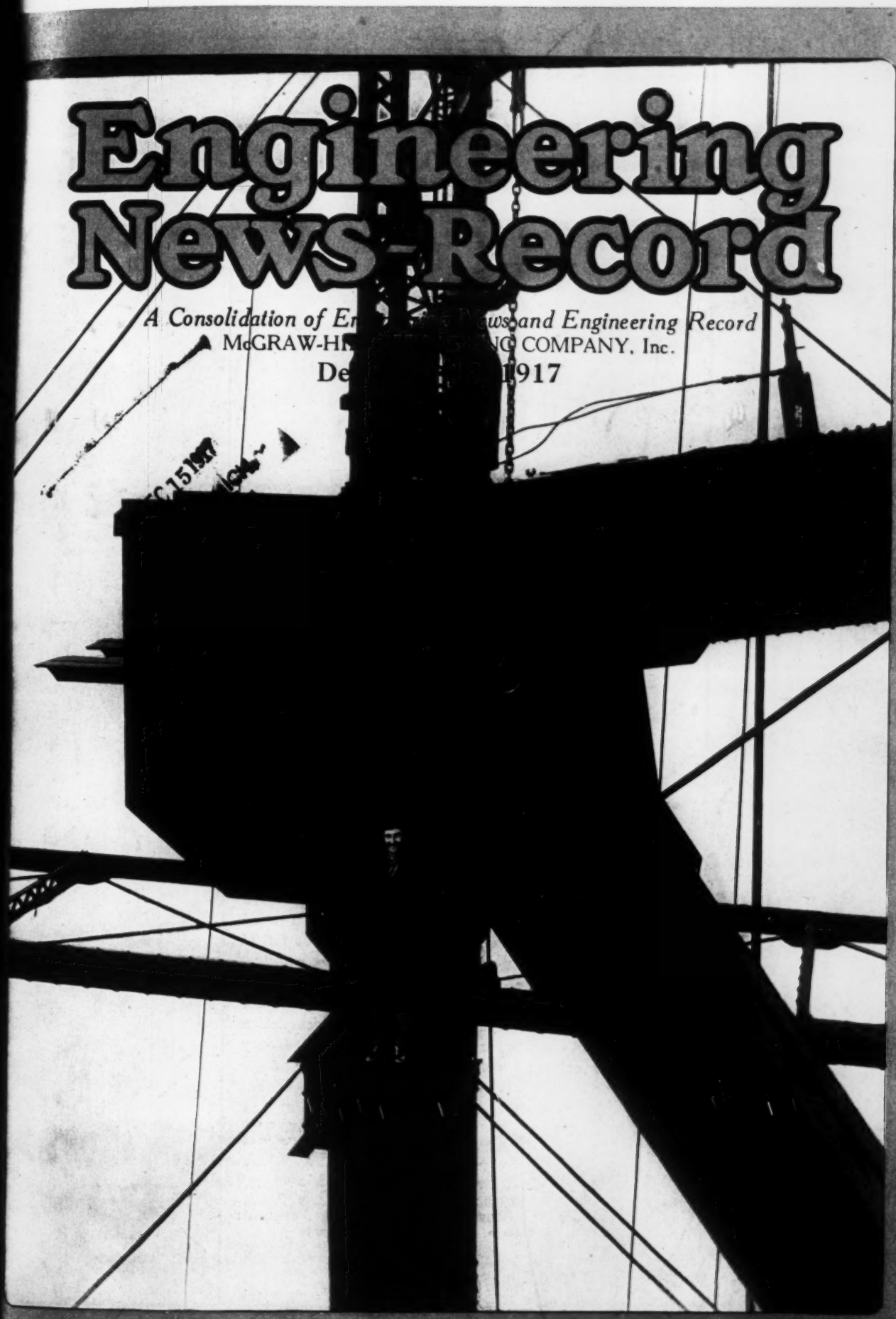

Cover released by courtesy of Concrete Steel Co., New York City

Kreolite Lug Wood Blocks
"The Paving that's Saving"

Business Men of Vine Street Like Kreolite Lug Wood Blocks

Vine Street is one of the noted streets of America whose traditional glory dates back to the old days of "Over the Rhine" and which is traveled today by many millions of people; is as full of life at midnight as any street in the country. The Central Vine Street Business Men's Association endorsed Kreolite Lug Wood Blocks for the paving of their street, and on its completion and opening for traffic gave an outing to Coney in celebration of the event.

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AND CONTRACTING

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Civil Engineers Welcomed to New Home

LAST Friday night the American Society of Civil Engineers was formally welcomed to its new home. It was an auspicious occasion, not the least impressive feature of which was the hearty good-fellowship by which it was characterized. There was enough of formality to lend the appropriate dignity; enough of cordiality to show that the welcome came from the heart and not merely from the head. Many were the suggestions as to the broader meaning of the occasion, but in this all agreed—that it was the outward sign of a movement toward unity in the profession. It was felt, too, that this day was the beginning of greater things for the engineer. There will be none to dispute this interpretation of the event; none to withhold their help that the greater things may be accomplished. With 32,000 strong men working together and organized for action, the profession can count upon playing a part in the nation's life such as has not even been hinted at in the activities of the past. The present crisis urges to action. The union under one roof has come at an auspicious time.

War Terminals and Traffic

LAST week Irving T. Bush, Chairman of the War Board of the Port of New York, urged the creation of a water terminal board to handle in an executive way all export shipments during the war. Almost at the same time the railroads of the country recommended to the administration the appointment of a traffic manager to prevent the confusion which now exists by reason of the various executive officers issuing orders for urgent freight movements without coördination among themselves and without knowledge of conditions under which freight must be moved. Meantime, it is understood that the committee on port facilities of the Council of National Defense, which has been making a study of the subject, has recommended that the comprehensive terminal plan which it has worked out shall be administered by central authority in the War Department for the purpose of handling all supplies for the forces of the United States abroad. These three recommendations coming from entirely different sources only emphasize the fact that this well-recognized problem is pressing for immediate solution, delayed only by action on the railway situation. It is evident that an executive authority with power to regulate the shipment, handling and loading on ocean carriers of freight other than that for the army is just as necessary, if congestion and delay are to be avoided, as a proper executive authority to meet the transportation needs of the War Department itself. Whether two terminal boards or traffic managers are needed or whether one central authority would serve the needs of the War Department better is questionable. In any event, the situation requires that settlement of the difficulty should come quickly.

The Real Issue as to Sewage Plans at Cleveland

IN THE latest stage of the Cleveland sewage-treatment plans the real issue before the State Department of Health—in fact the only issue—was whether available data indicate that fine screens will meet the local requirements laid down some years ago by the old State Board of Health. As stated on page 1128, the decision was in the negative. The advocates of screens will be given another chance to prove their claims, but conditions may compel the city to treat the screened sewage by the activated-sludge process. This would apparently be going much farther in sewage treatment than would otherwise be necessary to satisfy the State Department of Health. So much remains to be learned about both screens and activated sludge that engineers and cities facing sewage-disposal problems will be glad to have Cleveland provide data on both processes from a large plant if it is disposed to do so—all the more glad if the data pass the scrutiny of the Ohio State Department of Health.

Carrying Your Terminal Facilities with You

WE HEAR much about terminal congestion. There is discussion of their relief by the highways. Just how that relief can be afforded is shown by two examples cited by Col. William D. Sohier, chairman of the Massachusetts Highway Commission, at the Richmond convention of state highway officials last week. At the time of the Salem fire, it was desired to obtain tents from the armory at Framingham, 26 miles south of Boston. Salem itself is 16 miles north of the Massachusetts capital, so that the distance was 42 miles. The tents were on the ground at Salem three hours and ten minutes after they were 'phoned for. The other instance cited by Colonel Sohier was the moving of a regiment with all its equipment, cooking apparatus, etc., in two hours from Framingham to Boston Common, 26 miles. Had the railroads been utilized for either of these jobs, it would have been necessary to employ terminals at both ends. With the motor trucks and the highways, however, as one engineer aptly expressed

it, the terminal facilities are carried with you. Aside from relief of terminal congestion, there was, in addition, the time saved, for it would have been impossible to accomplish either of these jobs so quickly had it been necessary at the point of initiation to truck from the armory to the railroad station, then to load on railroad cars, and finally, at the delivery end, transfer from cars to local transportation agencies. Truly, the motor truck does allow you to carry your terminal facilities with you.

Industries Using the Highways

ANENT the preceding note, attention is called to the replies received to the *Engineering News-Record's* inquiry regarding the use of trucks and highways for relieving freight congestion. The inquiry was necessarily hasty. There was no attempt to find all examples of such use. The replies, however, published in the issues of Nov. 29 and Dec. 6 are conclusive evidence that the value of the highway as a relief agency is not a matter of theory, but is fully appreciated by the industries of the country. Every day new evidence of such use comes to hand, but sufficient has been presented to satisfy the present purpose—that of demonstrating clearly that the manufacturers of the country are turning to the highway to relieve them of the embarrassment of express and freight delays.

Influence of State Highway Officials' Association

THE American Association of State Highway Officials has found itself. This statement is no reflection on the conduct of the organization in the past. Every new body must go through an evolutionary process before it reaches full effectiveness. The association has progressed fast. It was organized in November, 1914. The members have now come to know each other well, and a frankness, based firmly on mutual understanding, has been developed that results in action and augurs well for the future. The organization already has great influence. It is the body with which the Secretary of Agriculture and the Director of the Office of Public Roads logically deal in connection with the general problems rising out of the administration of the Federal-Aid road law. But the organization has even greater potential power. Its members are the responsible factors in the road policies of the states. As such they are in a position to set new standards for highway construction, to bring about uniformity in state highway laws, and to exercise a large influence on such matters as the regulation of motor vehicles. Moreover, since highway standards, on account of the increase in heavy and fast motor-truck traffic, are rapidly approximating city pavement standards, it is inevitable that the association's influence will be felt in the municipal pavement field. The Richmond meeting showed plainly that the organization is attuned for action. No evidence was needed to demonstrate the ability of the members individually. Their positions in their states guaranteed that. Richmond merely demonstrated that they are equally efficient collectively.

Criticism Not Insult

IN HIS address before the American Society of Civil Engineers on the history of the society, delivered in New York Wednesday of last week, the secretary, Charles Warren Hunt, arraigned this journal for its editorial of Nov. 22 entitled "And They Are Fighting in France," stating that it was an attack upon the loyalty of the society and an insult to the board of direction and to the membership. The pertinent part of his address appears on page 1091. This journal and its two predecessors have frequently commented upon the American Society of Civil Engineers. The tone has always been one of respect, never of insult. Criticism has been voiced, but joined with admiration of the organization and appreciation of the place it holds in the profession. Nothing could be further from this journal's intentions than to question the loyalty of the body or to offer insult to the board of direction and the membership. Comment was intended on the fall program of the society, which we believed should contain war subjects. Nothing else. Suffice it to say that if Mr. Hunt's interpretation represented the attitude of *Engineering News-Record* we would consider his reply not only justified but moderate in tone. For any offense we have unwittingly given we duly apologize.

Engineering Students Allowed to Continue Their Courses

THE engineering-student exemption order of Dec. 8, published in detail in the news pages of this issue, closes the long agitation for the recognition by the War Department of the importance of conserving the supply of engineers. Members of the profession have been as one in their contention that to shut off the supply of engineers at the source, in order to increase slightly the rank and file of the army, would be dangerous. On the other hand, they have realized that a demand for universal exemption of engineering students would be unwarranted, for no engineer would be so bold as to assert that every student at our engineering colleges will become an engineer, the exercise of whose technical talents will be of more use to his country than his services as a private of the line.

By the ruling the dilemma is met by permitting the more promising students to complete their engineering courses, and then present themselves to the government for assignment to duties, probably military though possibly civilian, selected with due regard to their qualifications as engineers. Thus will be met the danger that the engineering school will become a refuge for draft evaders, and the more present danger that the engineering student of draft age, in his anxiety to serve, or in some cases to escape the charge of being a slacker, will volunteer in some non-engineering capacity. As it now stands, the designated engineering students will be "in the military service of the United States," and will know that they are serving their country according to the country's needs.

There may be some room for argument as to the proportion of exempt students, but that decided upon is according to the best judgment of the army officials and many of their advisers from the technical schools. It will undoubtedly work out much better than the original-

ly intended flat one-third of the present classes would have worked, for now the low-grade man cannot benefit by the voluntary enlistment of those above him in class standing or promise of future development.

The ruling, it is clear, puts a large responsibility on the engineering faculties. They must make their judgments on a human rather than on a purely scholastic basis, and must judge their present material in the light of experience with the professional progress of past students. The question up to them is not so much "How good a student is this boy?" but, "How good an engineer will he turn out to be?"

Action by the State Highway Officials

TWO things stand out in connection with the meeting of the American Association of State Highway Officials at Richmond last week—the vigorous action on the interpretation of the post-road clause in the Federal-Aid road act, and that on the highway problem as affected by the war. With reference to the first, the association called upon the Secretary of Agriculture and the Attorney General to interpret the post-road clause more liberally, while steps were taken to have the essential road work plans put into the form of a program for presentation to the Highways Transport Committee and to the Priority Board. We are sure that the interests of highway development throughout the country were very greatly furthered by these actions.

In reference to the call for a more liberal interpretation of the post-road clause, every one must have the greatest sympathy for the arid states. Under the present interpretation federal aid cannot be granted unless the route in question may be expected at a reasonably early date to be used for mail carriage. In the arid states, the long trunk lines go through great desert stretches without habitation, and it will be many a year before there will be mail service over them. These states, therefore, are estopped by this interpretation of the law from making use of the federal-aid funds allotted them under the statute. In other words, under the present interpretation the law is void with reference to these states. Certainly, there could have been no such intention in Congress. In fact, had this possible interpretation been foreseen, it is all but certain that the law would not have been passed in that form.

The engineers of the far Western States, therefore, will have with them the sympathy of highway engineers throughout the country in their plea for a more liberal interpretation of the post-road clause.

In reference to highway problems as affected by the war, the association called upon all state highway departments to prepare a war program, involving the designation of the essential war roads and of the amount of material needed for their construction and maintenance. These programs will clear through the executive committee of the association and by it will be presented in due course to the Highways Transport Committee and to the Priority Board. This is a most important and well considered action.

Moreover, every one at the Richmond convention will carry home to his state a very clear conception of the place that the highway holds in the war scheme, not only as an agency for the transportation of the agricultural and industrial products of the country, but as military thoroughfares should the occasion demand. This point of view will be of inestimable advantage in the preparation of the war programs which the departments will undertake.

Summarized, then, the meeting was a most important one for the engineering interests of the country as well as for the nation as a whole. At a critical period in highway development it faced the issues squarely, and took determined action. The personnel of the organization is such as to guarantee a carrying out of the plans proposed.

The Commerce Commission Recognizes the Railroad War Crisis

AT LAST the government seems to recognize the plight of the railroads. The Interstate Commerce Commission has indulged in the refreshing novelty of an extended recommendation to Congress, and, for perhaps the first time since its creation, has admitted that the railroads need constructive help rather than further regulation. The commission admits that if the railroads are to carry the burden thrust upon them by the war, they must be relieved of the restrictions which have been thrown about them by Congress, and must have the financial backing of the government.

As to the methods by which these restrictions may be removed and this aid extended, the commission makes two suggestions. The first is that the railroads continue under private management, with the repeal of restrictive acts, at least for the duration of the war, and that they be given the assistance of government loans. Under the second plan, the government would take over and operate the railroads, guarantee a return to the present owners and spend its own money to bring the roads up to the physical requirements of the situation. Were government participation in railroad affairs forced in peace times, this journal would unqualifiedly prefer the former of these solutions. In war times, however, the power that may be delegated to railroad officials taken over by the government with the lines may be so great and so freed from political interference that efficient operation can be secured. Moreover, the future is so uncertain, the problems that may arise are so large, that perhaps direct government handling is the only possibility for meeting the situations effectively. Under present circumstances selection between the plans is difficult. The tendencies of the times unquestionably are in the direction of government operation.

Perhaps it is unfair to characterize this new attitude of the commission as an admission of the failure of the restrictive regulation that has been in effect for more than a generation. War conditions like the present could not have been foreseen even five years ago. *Engineering News-Record* rejoices that the commission has reversed its position of last summer and now perceives that there is an emergency. At the same time it is evident that either plan will require masterly handling for maximum effectiveness on the one hand and justice to both the public and the security holders on the other.

With developments coming thick and fast, and with an address expected in the near future from the President to Congress, further comment on the plans can best be deferred to a later issue.

Concrete Shipbuilding Firmly Established by Norwegian Firm

Company Founded Eighteen Months Ago Has Well Developed Shipyard and Has Turned Out Twenty Concrete Vessels, from Small Lighters and Tugs Up to Floating Dry Docks and 1600-Ton Sea-Going Freighters

REINFORCED-CONCRETE barges and ships up to 1600-ton capacity have been built in the past year by the Fougner Steelconcrete Shipbuilding Co. in its yards at Moss, near Christiania, Norway. This company, which was formed in May, 1916, started in to build small concrete lighters or barges, but by gradual development worked into the design and construction of larger towboats and finally of self-driven vessels of small tonnage. It now has on the ways power-driven ships of 1600-ton capacity and, under contract, awaiting the approval of the marine registry of the Norwegian Government, a 4000-ton freighter. All of these vessels, as well as a floating dry dock, have been built under contract for commercial or governmental use.

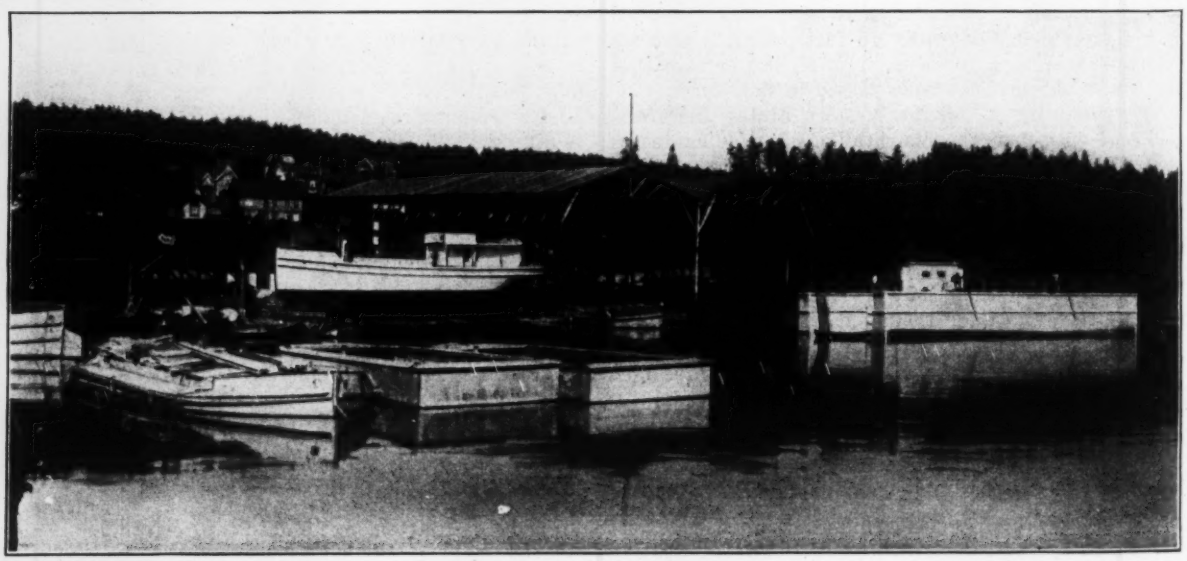
The company was founded by Nic. F. Fougner, a Norwegian engineer who has had extensive experience in reinforced-concrete construction in the United States and the Far East. Mr. Fougner in 1914 built in Manila a 50-ton concrete lighter which was put into immediate service and has been in successful use ever since. Encouraged by this venture, he returned in 1916 to Norway and built the plant at Moss, from which have been turned out about twenty reinforced-concrete vessels and which is now about to be enlarged to take care of orders for more boats.

The first vessels turned out in the yard were lighters of about 100-ton capacity of the general type shown at the left in the view of the yard. The structure comprised a reinforced-concrete keelson, reinforced ribs and a thin shell of concrete plastered on expanded metal or poured around rods. This variation of plastered and poured concrete continues through the Fougner practice today, as will be explained later.

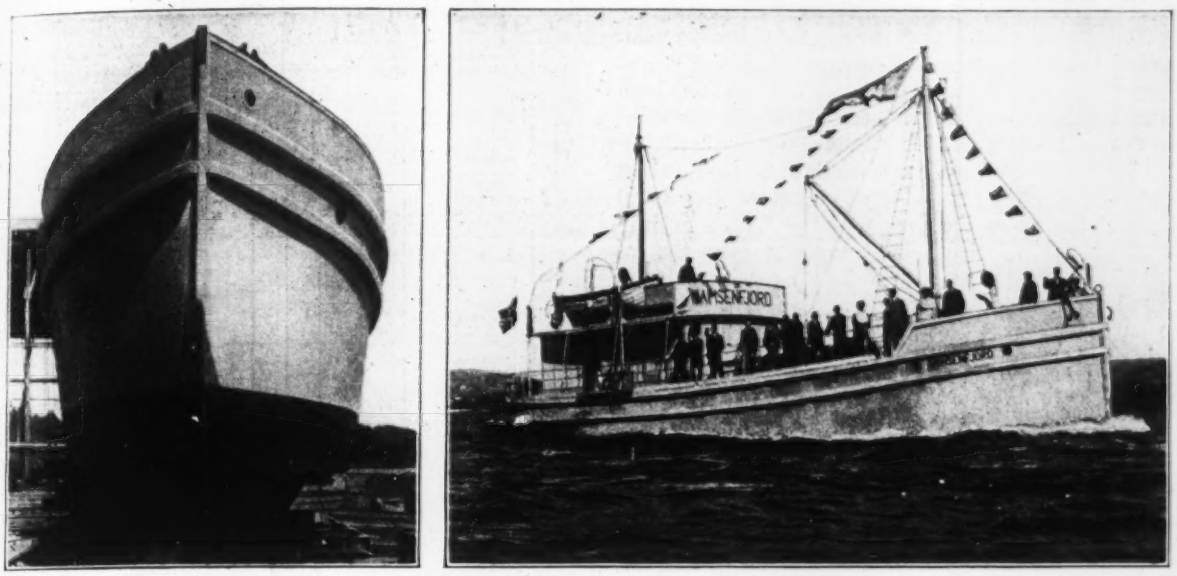
From the lighters progress was made to formed scows or towboats, up to 200 tons capacity. One of these is shown in one of the views. These boats have the more developed shape of a ship, but otherwise resemble the earlier scow. A number are in use for coasting tows up and down the Norwegian coast and one or two have been bought by the Norwegian Navy.

Late in the past summer the yard built and launched its first sea-going boat, the "Namsenfjord," which also is the first concrete sea-going boat. It has received the Class A-1 rating from Lloyds and is now in service for Norwegian coastal traffic. Some views and drawings of the "Namsenfjord" are given herewith. Although very much smaller than the concrete boats now under construction in the Moss plant, its construction is typical of the Fougner design and will therefore be described.

The "Namsenfjord" is 84 ft. long, 20 ft. wide, and 11½ ft. deep from deck to keel, having a draft of 9½ ft. It is 200 tons dead weight, or 350 tons capacity, and is driven by a Bolinder crude oil engine of 80 b.-hp., permitting a speed of about 7½ miles per hour. The cross-sections shown herewith give an idea of the construction. Briefly, there is a reinforced-concrete keelson with cross-frames of reinforced concrete every 4 ft. These frames are continuous along the sides and bottom of the boat, and are tied into the keel by rod reinforcing. Particular attention is paid to the continuity of this rod reinforcing in the transverse frames, so that the bottom, side and deck frames, though cast separately, will form a rigid member. This is insured by continuous rods and by additional knee-brace rods at the corners of the hull. The skin, 3 in. thick, is of concrete reinforced with wire mesh or expanded metal. It is tied into the



YARD AT MOSS, NORWAY, WHERE CONCRETE BARGES AND SHIPS ARE BEING BUILT



CONCRETE STEAMER "NAMSENFJORD" ON THE WAYS AND ON TRIAL TRIP

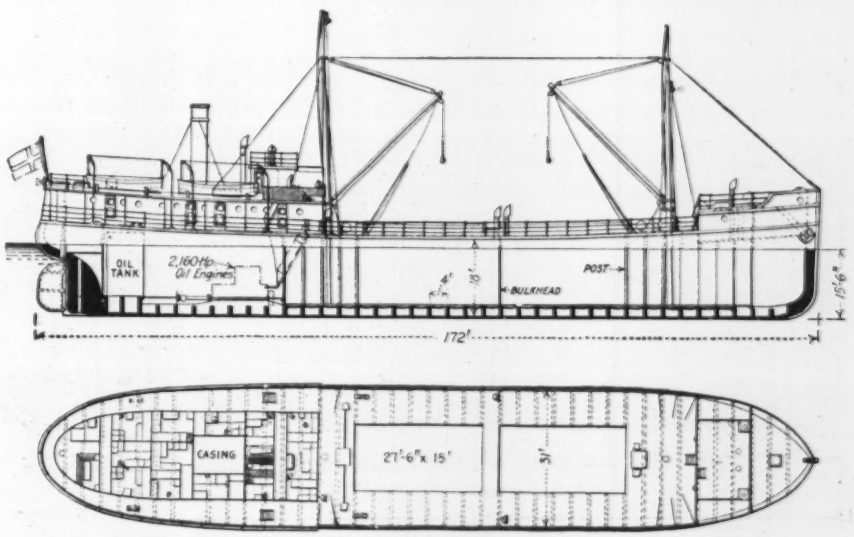
frames and especially reinforced with a longitudinal beam at the outer corners of the hull. There are center posts at intervals, of light wrought-iron pipe filled with concrete, supporting deck-beams which frame at the side into main frames. Two hatchways are provided of a construction shown in one of the sections illustrated. The hatch coamings are longitudinal beams framing at their ends into main deck beams and carrying the deck alongside the hatchway on beams which are partly cantilevered from the side frames and partly flexural beams across to the hatchway coaming. A double bottom is provided by precast concrete plates spanning the tops of the keel frames and tightly jointed over these frames. On top of this interior plating 2 x 4-in. timbers are laid above each frame and on them are spiked the 2½-in. floor timbers for the hull.

The hull is divided into water-tight compartments by continuous transverse bulkheads, located as shown on the elevation of the 1600-ton ship. These are walls of concrete, reinforced with metal lath.

A special reinforcing of longitudinal and cross beams is provided for the engine bed, as shown in one of the small cross-sections. The engine exhaust is through the rear mast, which is hollow. The cabin is of wood. Wooden fenders are provided along the hull and a wood stem is bolted to the bow. The rudder and its fittings are of iron.

In building this hull the bottom is poured in wooden forms up to the top of the longitudinal hull beam at the lower corners of the hull. For the sides the framing is either plastered or poured, depending upon different conditions. For a small boat, such as the "Namsenfjord," the reinforcement, both the rounds and metal lath, is erected for the total height of the hull and concrete poured in between the metal lath, using it as a form. The outside and the inside of the lath are then plastered to give the full section. In higher boats this process is duplicated, except that short heights of lath are put in at a time, thus leaving a smaller lift of concrete at one operation. For a still larger boat, where the unsupported reinforcement would be too flimsy, the usual wooden forms are used for the main frames and the concrete poured as it would be in any concrete construction. The construction is continuous for the whole hull, however, so that no joints are left in the surfaces exposed to water. Concrete is placed continuously, even though it takes 24 or more hours of work.

The same variation between plastered and poured concrete holds for the deck construction, convenience of



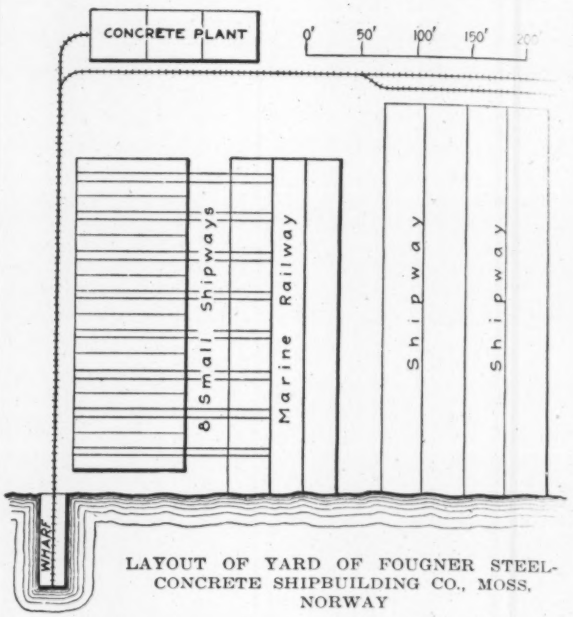
GENERAL LAYOUT OF 1600-TON REINFORCED-CONCRETE POWER DRIVEN SHIP NOW UNDER CONSTRUCTION

operation and the stiffness of the reinforcing being the governing considerations. It is reported that the "Namsenfjord" is remarkably stable and steady. Moving pictures of it in the harbor of Christiania which have been shown in this country seem to bear out this contention.

A drawing of the 1600-ton boat is also given herewith. This boat is 172 ft. long, has a width of 31 ft., a height of 18 ft. and draws about 15½ ft. of water. In general details it resembles the design of the "Namsenfjord" except of course it is made stronger to meet the increased size. It is also provided with considerably increased accommodation for crew. Two of these boats are on the ways at Moss, one to be launched in December and the other in January. The company has also contracted for a 4000-ton capacity ore carrier for the Sydvaranger Mining Co. of Norway. This boat is 254 ft. long, 40 ft. wide, and has a 19½-ft. draft, and is to be equipped with two 300-b.-hp. Diesel engines. The keel has been laid for one of these large boats, but further construction is awaiting the authorization of the Norwegian Marine Registry, which has a committee investigating it preliminary to authorizing its registration under the Norwegian flag.

The concrete ships built according to the Fougner system have a ratio of dead weight to displacement from 12 to 15% greater than the similar ratio in steel ships.

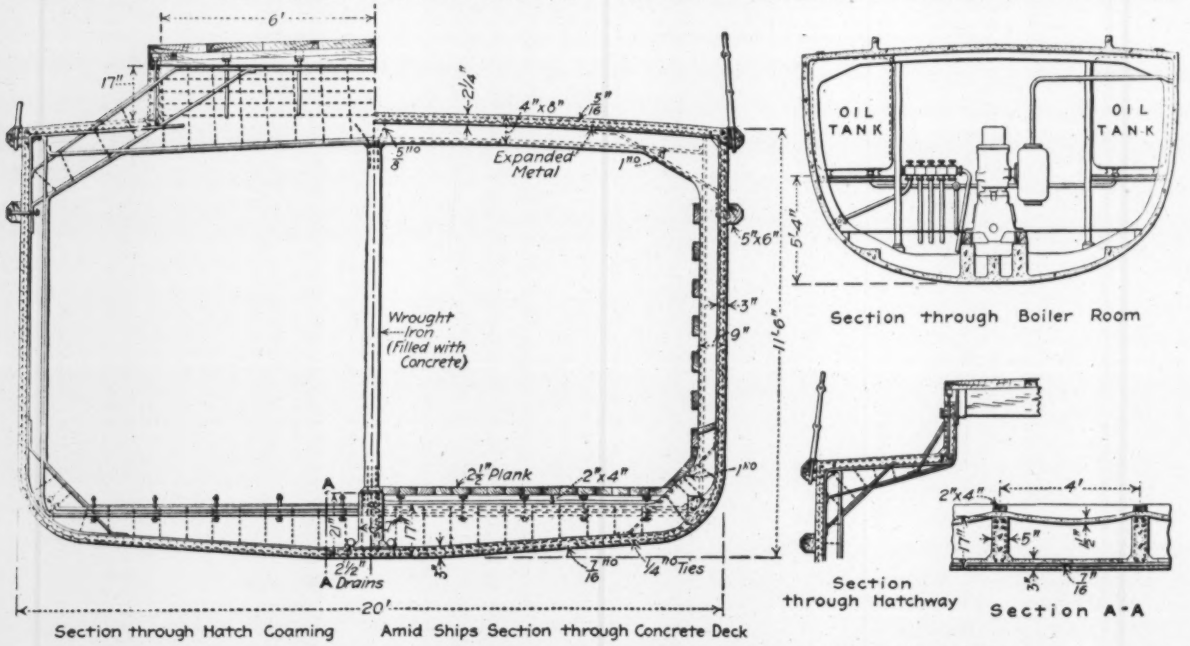
A view and drawing are also given herewith of the Moss yard. There are here eight covered ways parallel to the water front, on which are poured the smaller vessels. These ways are about 100 ft. long and are reached at their rear by a narrow-gage railroad track connecting with the concrete plant. At the front of the ways is a marine railway leading to deep water. The boats are constructed under the covered ways in timber platforms resting on rollers on the rails of the shipways. By means of these rollers the completed hull is shoved down on the marine railway, from which the hull is launched sideways. In the view the "Namsenfjord" is on this marine railway just preliminary to its launching.



LAYOUT OF YARD OF FOUGNER STEEL-CONCRETE SHIPBUILDING CO., MOSS, NORWAY

Beyond the marine railway are two covered shipways for the construction of the vessels of larger size. These are about 400 ft. long and will accommodate the largest boats now under construction in the yards. The large ways are of the normal beam-and-pile type, and the launching from them is to be done stern on.

Behind the shipways is the concrete plant. The sand, gravel and cement are brought in by boat to the wharves at the end of the narrow-gage track and transported by cars on that track to bins over the mixing plant. Here two mixers turn out the concrete into cars on the narrow-gage track, which run behind the small ways. Hooks traveling on overhead longitudinal rails in the middle of each shipway pick up the concrete buckets off the small cars and sliding down the ways by gravity deposit the concrete whenever desired for the hull. The



DETAILS OF CONSTRUCTION OF "NAMSENFJORD," 320-TON CONCRETE STEAMER

hooks and buckets are hauled back by power winches. For the large ways the same performance is repeated; that is, the tracks run to the rear end of the ways, where longitudinal overhead trolleys pick up the buckets to distribute the concrete anywhere along the shipway. All power is electric, bought from the municipality, which runs a hydro-electric plant.

Considerable experimenting has been done with the concrete materials for the ships, but a conclusion has finally been reached to use a mixture of 1:2½ of cement and a natural gravel found nearby, the largest particles of which do not run over ¼ in. In the earlier work a 1:1½:2 or 1:1½:2½ concrete, with the large aggregate not running over ½ in., was used, but later developments showed the small aggregate to work better around the steel in the small sections of the ships. Particular attention is paid to the mixing and proportioning of the concrete, expert engineers being employed as inspectors for this part of the work. It is claimed that the resulting concrete is quite water-tight.

First Concrete Dry Dock

In the view of the shipyard is also shown the floating dry dock which has recently been completed by the company, the first concrete dry dock ever built. This is of the usual type of floating dry-dock design, with poured and plastered sides and poured frames. It is to be used by a company building pleasure craft and will float a ship up to about 100 tons. The company has also recently built a tug, which is not shown in any of the views.

The Fougner Steelconcrete Shipbuilding Co. has been incorporated in the United States and has offices at 18 E. 41st St., New York City. Nic. F. Fougner, the president, is in this country at the present time arranging for the development of a yard where concrete ships may be built.

Automobile Costs on Sun River Project

Costs of running two 5-passenger automobiles on the Sun River Project of the U. S. Reclamation Service for 1916 were as follows: No. 1 ran 7726 miles at 11.28 cents per mile; No. 2, 5280 miles at 10.85 cents per mile; No. 3, 7089 miles at 7.92 cents per mile. The first car, according to the *Reclamation Record*, closed the year with a total mileage of 28,975 miles. Although the car was overhauled and in good condition, its operation was not considered economical, on account of the cost of repairs and delays from such cause. It is estimated that the machine did work that would have required the constant use of two good driving teams used alternately. The average cost of feeding a team on this project is $1.40 per day. If there be assumed a plant charge of 60 cents—the average for the project for the 1916 season—against each team and wagon, and 30 miles for an average day's trip, the teams would have cost 15.23 cents per mile. This is based on 730 team days and 258 plant-charge days. Comparative team-unit cost for the year's travel for No. 2 machine is 12.67 cents. Only one team would have been necessary. To transport by team the resident and construction engineers using the No. 3 machine would have required two single driving horses at a unit cost of 8.3 cents.

Society's War Activities and Journalistic Criticism

Secretary of American Society of Civil Engineers Discusses Recent Editorial in Engineering News-Record

AT THE meeting of the American Society of Civil Engineers in New York, Dec. 5, Mr. Charles Warren Hunt, secretary of the society, gave a history of the body for the past 25 years. In the course of his paper, Mr. Hunt recounted the war activities of the organization, and criticised an editorial which appeared in *Engineering News-Record* of Nov. 22, p. 951. That portion of Mr. Hunt's paper relating to war activities and to this journal's editorial is reproduced herewith. Editorial comment will be found on page 1086.

Mr. Hunt's Paper

The pertinent part of Mr. Hunt's paper follows:

In a recent issue of *Engineering News-Record* the following editorial appears:

"And They Are Fighting In France." "The 'Subsidence of Muck and Peat Soils in Southern Louisiana and Florida' was the title of a paper presented two weeks ago at the meeting of the American Society of Civil Engineers. With the exception of three war addresses, equally peaceful topics have occupied the meetings since last April. The fall program, so far as announced, contains no papers bearing on the tremendous industrial and engineering problems which the winning of the war demands that we solve. This is an engineering war, yet the society seems not to recognize its opportunity."

It is unfortunate that such an improper, unfounded and sarcastic editorial insinuation should be made about an organization whose aims and objects are clearly unselfish, in a commercial publication on which the profession in a large measure depends for its technical news.

The time for this attack upon the loyalty of this society—just after it has become one of the founder societies—leaves an impression of malicious intent.

Of late all of us have heard much of the use of previously unheard-of methods of warfare, and the writer feels sure that every right-minded member of our allies of the mining, mechanical and electrical societies will unite with the members of this society in condemnation of this misuse of editorial prerogative.

It is hoped that the following brief statement—written before the appearance of this insult to the board of direction and to the membership of this society—will be a sufficient answer.

War Activities

As soon as war was declared, the society placed its facilities at the disposal of the Government, and, both as an individual organization and jointly with the other founder societies, has done all it has been asked or permitted to do. The value of the engineer has been recognized to a greater extent than ever before, and in the wonderful progress made in raising, training, transporting and maintaining the new Army of the United States, as well as in the investigation and solution of new problems, he has been a most important factor.

A joint committee representing the national societies,

of which William Barclay Parsons, M. Am. Soc. C. E., was chairman, was active in securing the legislation which provided for the Engineer Reserve Corps, and committees made up of members of these societies have been instrumental in recruiting engineer regiments in many parts of the country.

In 1915, in the absence of President Marx, the writer was requested by a sub-committee of the Naval Consulting Board to coöperate with it and representatives of other national societies, to formulate plans for industrial preparedness. He reported to the board of direction, on Jan. 17, 1916, that a plan had been developed by the sub-committee, acting in conjunction with the five national societies representing the civil, mining, mechanical, electrical and chemical engineers, for securing complete statistics of the industrial strength of the country. Under this plan, in each state of the Union, one representative, recommended by each of these societies, was appointed as an associate member of the Naval Consulting Board, and the five engineers thus appointed in each state constituted a board to secure the necessary information for the Government through the aid of the more than thirty thousand members of these organizations. As is well known, this great work was carried to a successful conclusion.

In these and in many other ways the society, and its board of direction, has been active in the present emergency.

Every member of the society must read with pride our "Roll of Honor," the first issue of which, incomplete as it undoubtedly is, contains the names of 575 engineer officers who are now serving in the army and navy. Since that list went to press, 148 have been added to it, and it is still incomplete. This means that more than 8½% of the entire membership wears a uniform. The list, however, does not contain the names of hundreds of other members who are serving their country unobtrusively but still no less unselfishly and effectively, on advisory boards or simply as citizens. The writer knows of many cases where at great personal sacrifice such work has been and is now being done.

Only a few days ago a suggestion was made somewhat timidly over the telephone by J. W. DuB. Gould (one of our members who is devoting his time to the service of the Government but who is one of those not mentioned as not listed on our "Roll of Honor") that perhaps the society might consider some arrangement by which the United States Food Administration could secure the use of the house we so recently vacated, in order to carry on its work in New York City and State. The writer at once said that he believed that the society would be glad to offer this house for the use of the nation, for the purposes specified, free of charge.

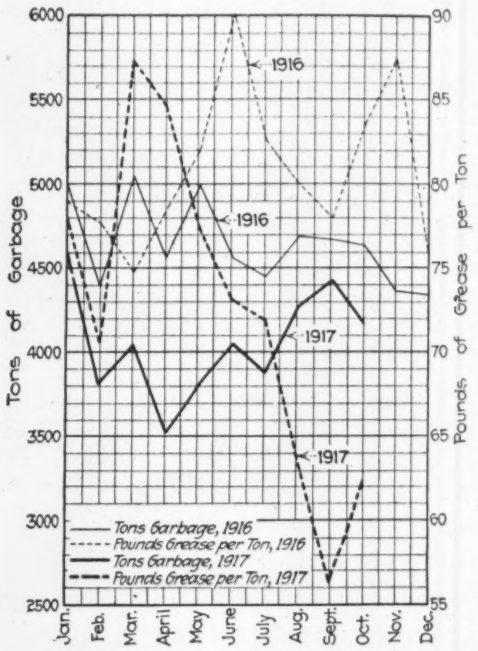
It was not possible to get the board together; indeed, in these busy times, a meeting of the executive committee is difficult to secure. By telephone, however, each available member of that committee has given his unqualified and enthusiastic support to the proposition; the arrangement has been made, and the United States Food Administration Board will begin work at our old home on Friday of this week.

It is perhaps unnecessary to state that the head of this most important board is a member of this society—Herbert C. Hoover.

Quantity and Quality of Garbage Lowered by War Conditions

Figures from Boston Show Marked Reduction in Amount of Grease Recovered from City Wastes

MARKED reductions both in the output of municipal garbage and the amount of grease recoverable from it this year, as compared with 1916, are disclosed by figures compiled by the Boston (Mass.) Development & Sanitary Co., which has the contract for handling the bulk of the city's household wastes. The accompanying curves tell the story. Two reasons, it is believed, have combined to produce this result—the increased cost of



HOW HOOVER FOOD CAMPAIGN AND HIGH COST OF LIVING IN WAR TIMES HAVE REDUCED QUANTITY AND GREASE CONTENT OF BOSTON GARBAGE

virtually all food stuffs, and the conservation campaign of Food Administrator Hoover and his staff.

Taking the figures for August, September, and October, 1917, it is seen that the amounts of grease obtained per ton of garbage were 62.1, 56.4 and 63.7 lb., as against 80, 78, and 83.6 lb. during the same months of the previous year. A comparison of the total quantities of garbage produced during the two years is also highly significant, especially when it is pointed out that normally an increase of about 5% can be expected, due to growth in population.

The inference to be drawn from these figures, is, of course, that war conditions are stopping waste in Boston kitchens. Not only this, but families in Boston are consuming less meat than formerly, as is indicated by the smaller quantities of grease recovered from the garbage. The results are particularly valuable in that they show the changed conditions to be expected in the operation of public or private garbage reduction works.

Military and Other Highways in War Time

An Address, Slightly Condensed, Delivered Before the American Association of State Highway Officials at Richmond, Va., Dec. 4, 1917

By William D. Sohier
Chairman, Massachusetts Highway Commission

THE subject of military roads is one of the utmost importance to the world at the present time; in fact, the results of the war really are going to depend fully as much upon roads and highways as they are upon any other one factor, because it is manifest that if you cannot feed your men, move your guns, supply them with artillery and ammunition, you cannot maintain an army in an existing location.

While the railroads and steamships are vitally necessary to bring the supplies and men, ammunition to the artillery, and everything needed for modern war, to the country, and from the large storehouses to the railheads, the soldiers in the trenches, and more particularly the soldiers back of the trenches that are holding the long battle lines, have to be almost entirely supplied over the roads.

Which Highways Are Important

The whole battle of Verdun was really fought, as far as the French were concerned, with soldiers, ammunition, guns, and supplies that were transported over the roads, because one railroad which originally supplied that region was cut by the Germans, and the other one was dominated by their artillery. The consequence was that the army was supplied with ammunition, guns and men that came over the roads.

From one point of view, all roads which are of any importance are military; to wit, any roads which have to be used for the transportation of any of the products which are necessary for the conduct of the war or the feeding of the people with the articles that are necessary to sustain life. It is a question of relative importance, but under existing conditions we should certainly confine our efforts to those roads which are of the most importance from this point of view.

Military Roads in France

Virtually all of the roads in France were military roads. The French road system was admirably adapted to be used for military purposes. This can be illustrated by a few figures:

France, with a population of ten times that of Massachusetts, and an area of about twenty-five times the area of Massachusetts, had, when the war started, over 371,000 miles of macadam road. These roads had been built for many years; they were all graded, with foundations where necessary, and all had adequate drainage. Virtually all had a hardened surface of waterbound macadam, though a certain percentage had been built with a bituminous surface.

There were about 32,000 miles of national or departmental highways, or about 10% of the whole. These main arteries connected all the more important cities and villages with a network of main highways through the whole of France.

The width of the "Route Nationale," including ditches, was 60 ft.; the macadam surface was usually 24 ft. wide, with about 15 ft. of graded road on each side and then a ditch. The "Route Departmentale" was about 42 ft. in width, with a macadam surface usually about 18 ft. wide.

Secondary Roads

There were also over 107,000 miles of road of secondary importance, what might be called county roads, connecting all the little towns, villages and hamlets. There were 47,500 miles of road that were perhaps of interest to two or more towns. These roads were graded about 30 ft. in width, including ditches. Then there were about 184,000 miles of what might be called ordinary country roads.

The roads of the least importance had a macadam surface about 9 ft. in width, but were graded 27 ft. in width.

So far as I can learn, it was this road system which enabled the armies of France to stem the German armies' rush on Paris, and to throw them back to where the trenches were first made.

France has been so well supplied with roads in most of the sections on the battle line that it has been unnecessary to build very many more, except in particular places. The big problem has been to keep up and maintain what they had, with the tremendous traffic that had to go continuously over them.

In a few instances, when the battle line became established certain roads and cross roads were so located, for instance, near Verdun, that they were easily visible and subject to shell fire. Therefore, a few miles of road have been relocated on the lee side of the hills where they were out of sight of the German batteries and relatively safe from shell fire.

Maintenance

The traffic has been so tremendous that naturally the roads have been very rapidly worn out, and as they had to be kept in continuous use, certainly whenever that particular section of the battle line was active, it was impossible to do more than throw material onto the road and allow the traffic to roll it down.

When divisions have to be moved the utmost capacity of the main roads is required for the trucks, artillery, etc., and the slow-moving trucks and the light motor ambulances and other motor vehicles have to take longer routes on the roads of less importance, so that these country roads have been absolutely necessary during the war.

The slow-moving horse-drawn vehicles are required to hug the shoulders of the road, the fleets of motor trucks pounding steadily by in the middle, spaced about 50 ft. apart, traveling at from 12 to 15 miles an hour.

During the attack at Verdun, the Bar-le-Duc-Verdun road, about 50 miles in length, had to carry a continuous procession of about 5000 motor trucks every 24 hours.

The roads were kept constantly in repair by putting on broken stone whenever it could be obtained, though of course when any serious large break in the road occurred it had to be filled with any material available, quite often stone from the foundations of buildings, brick and other material.

Whenever there was a lull and it was possible to put the roads into better condition, it has usually been done by scarifying by hand and building half the road surface, possibly 1 or 2 in. in depth, of broken stone, in some localities obtained by rail but usually from some local stone supply, or the stone taken from the villages where the buildings had been destroyed. The stone has been broken up by hand, either at the source of supply or on the side of the road, and when it was possible steam rollers have been used to consolidate it.

When the actual fighting is going on it has had to be shoveled in from the roadside and allowed to compact under traffic, which it does very rapidly in wet weather. Occasionally clay or dirt has been used to help it bind.

This repair work has been done by men who were not of fighting age or by prisoners of war.

Experienced Road Engineer Necessary

The experienced road builder of executive ability has found his place in this war. The roads back of the English army are being built and cared for under the direction of Brig.-Gen. H. P. Maybury, who was one of the English county engineers and was afterward one of the engineers on the Road Board in England; and he has under him, in charge of the road work, experienced men. One of these men, formerly with one of our large companies, is now a lieutenant-colonel. Back of one of the British armies this engineer has had charge of the roads for two years, and has had from 10,000 to 12,000 men working on them constantly. Twenty-five or thirty per cent. of these have been German prisoners.

In order to keep the roads merely passable they have had to use up to 2000 tons of metal a day. Broken stone costs $7.50 a ton. It isn't a question of cost, however; it is a question of keeping the traffic going.

Experience in England

I fear the people in this country, and particularly our legislators, are not really awake to the tremendous importance of good roads if this country is to do its part in the world's war. They are important, not only from a strictly military point of view, but they are absolutely essential if the country is going to grow and harvest its crops, and supply not only our own soldiers but our allies with the food that they cannot live without.

The experience of England and what she has done since the war started, on her highways, is perhaps the best example that we could follow. England has not been invaded, but she has had to enlist, train and equip large armies, has had to organize to make tremendous numbers of guns, enormous quantities of ammunition and supplies of every kind.

It is very significant that she, with her tremendous network of railroads and small area, has found that her roads, especially the main roads, were of vital importance. With all the tremendous additional expenditures made necessary by the war, and with undoubtedly a large number of the uninformed public saying that she must save every dollar possible—why not stop some of the expenditures on roads?—she has not only not stopped these expenditures but has actually increased them in many places.

Highway Work in England and Wales

England and Wales have over 151,000 miles of road, of which 32,000 miles are urban roads and over 118,000 are classed as rural roads. The expenditures are shown in the accompanying tables:

TABLE I. HIGHWAY EXPENDITURES BY LOCAL AUTHORITIES IN ENGLAND AND WALES

Year	Mileage	Maintenance	Average Maintenance per Mile	Total Including Interest and Improvements
Urban Roads:				
1909	32,000	$21,415,590	$670	$51,651,625
1912	32,807	23,033,180	700	52,120,330
1914	33,624	25,612,680	760	54,918,810
Rural Roads:				
1909	118,692	19,627,950	165	20,814,405
1912	118,665	23,942,200	190	24,266,545
1914	118,461	26,965,385	225	28,592,035
Total Rural and Urban:				
1914	152,085	52,578,065	345	83,510,845
1915				87,836,655

TABLE II. HIGHWAY APPROPRIATIONS MADE IN ENGLAND AND WALES DURING WAR BY GOVERNMENT DEPARTMENTS

	By Road Board	Appropriations by War Departments For Public Roads	Total Government Aid
(a) 1914	$7,036,330		
(a) 1915	10,440,180		
(a) 1916	1,847,315	$5,256,655	$7,103,970
(a) 1917	1,006,660	2,011,835 (b)	3,018,495

(a) Financial year ending Mar. 31. (b) June 30, 1916 to Mar. 31, 1917.

TABLE III. WORK ON PUBLIC ROADS IN ENGLAND AND WALES SANCTIONED TO MAR. 31, 1917

By War Department	$5,925,790
By Admiralty	418,235
By Ministry of Munitions	886,940
By Timber Supply Department	36,525
Total	$7,267,490

Total expenditure on roads, public, private and government, by above department, expended under the supervision of the Road Board, to Mar. 31, 1917, $13,800,705.

In 1912, two years before the war, England was spending on her 32,000 miles of urban road over $50,000,000 a year, including improvements and interest. The average cost of maintenance was $700 a mile a year. She was spending on her 118,600 miles of rural road over $24,000,000 a year, including improvements and interest. The average yearly maintenance was about $190 a mile. On her road system the local and county authorities were spending over $75,000,000 a year, including improvements and interest, with an average expenditure of $300 a mile for maintenance alone.

This was an increase of about 10% over her expenditures in 1909. She had just established a Road Board which was existing in various counties and some municipalities with government aid.

The year that the war started this Road Board made grants for the improvement of various roads, amounting to about $7,000,000, in addition to the amounts that the other authorities were spending.

In 1915, the second year of the war, the local authorities were spending a little more than they spent in 1912 on the urban roads, about $760 a mile for maintenance in place of $700.

The revenue which the Road Board had been receiving up to that time from motor vehicle fees, taxes on gasoline, etc., was turned into the general revenue, and

their grants for the improvement of roads were reduced to $1,200,000.

This work was carried out under the direction of the Road Board, and according to its report it included the reinstatement of roads damaged by extraordinary traffic caused by the various departments interested in the war, and which had formed the subject of claims against the departments concerned.

The board states also that in some places improvements were required for the ordinary public traffic, in which case the Road Board and the highway authorities contributed.

What is particularly noticeable is that the heavy traffic, and particularly the motor truck traffic, was obliging the authorities, in order to keep the roads passable, to strengthen and improve the surfaces of the roads. As Table III shows, the war branches of the government, aside from the Road Board, spent no less than $7,267,490 on the public roads. The same departments spent a total of over $13,000,000 for roads on private land and on government land and on public roads.

When one considers the relatively small area of England and Wales, and the relatively small mileage that has to be maintained, these large expenditures are extremely significant.

Retrenchment Not Recommended

In the year 1916, apparently the Retrenchment Committee had suggested that highway improvements and grants for that purpose be discontinued. The Road Board, however, after considering the matter, fully decided that this ought not to be done, that "while the majority of schemes should be deferred, such work should now be undertaken as is required in connection with improvements of road crust necessary to prevent the serious deterioration of roads of real importance. We recommend, therefore, that such advances be approved by the treasury as are, in their opinion and in that of the Road Board, required in order to prevent such deterioration."

Consequently, that year they decided to approve grants amounting to $1,000,000; but, of course, in addition to this there were the expenditures that were made by the various war boards.

Military Roads in the United States

Certainly all highway authorities should coöperate to the utmost of their ability in building and maintaining the roads which are of vital necessity to this country.

Taking my own state—Maj.-Gen. Leonard Wood, U. S. A., when he was in command of the Northeastern Department, wrote Governor McCall, in substance, that the roads in Massachusetts were of the utmost importance, from a military standpoint; that we were well supplied with the regular diagonal roads, that he thought they were adequate for their purpose, but that it would be of inestimable advantage if proper radial and concentric roads were built which would connect the main arteries of travel and enable an army to be maneuvered and kept constantly supplied at whatever point might be made necessary by military exigencies.

Which roads are of military importance will differ in the different parts of the country. I cannot consider them all.

Roads connecting camps, places where troops are concentrated and from which they may be moved, or leading to forts or other points of military importance, are, of course, of the greatest importance from the military point of view. Also, the roads from the nearest railroads to such camps or forts.

Military Roads to Repel Invasion

Taking the country as a whole and considering merely the possibility of an invasion, the only serious possibility at the present time would be an invasion upon either the east or west coast.

Take the east coast; I think all military authorities will agree that the probable landing place of any foreign foe would be somewhere between Norfolk, Va. and Portland, Maine. The objectives of a foreign foe landing on this shore would undoubtedly be the thickly-populated and rich sections of the country, which would be comprised within a very small area, at any rate within a line drawn from Baltimore to Cleveland or Chicago at the west. If this territory were taken it would virtually cripple all of our industries, take a large proportion of the wealth of the country and would include nearly all of our manufacturing plants where we make ammunition or guns or ocean-going ships or warships, and a large part of our coal and iron supplies.

Military Roads on East Coast

In the New England States the roads of military importance would be the roads connecting the important centers of manufacture, supply and population, the radial roads in and out of the seacoast cities, and, perhaps equally important, a concentric road connecting up those radial roads to enable troops to be fed and supplied on any line which they might have to follow.

Near the cities that might be subject to attack, the military roads would be not only these radial roads, but say a concentric road a short distance out of the city 5 or 10 miles, and another lateral or radial road farther out, say 10 to 12 miles. It would probably be very desirable to have a secondary line running back from the seacoast 50 or 75 miles to connect up the larger places and the main roads.

The same sort of system of military roads would be necessary in the other states that might be subject to attack.

Of course, taking the country as a whole, a road would be of great military advantage that was back of the seacoast a sufficient distance and connected up our main centers of population and industry in the whole of the United States.

Mexican Border and West Coast

A good road along the Mexican border that would enable the troops to be rapidly concentrated, at any given point of attack, by motor trucks or even machine gun companies on motor cycles or small motor cars, would prove of great advantage in the case of any raid upon the border. Our troops suffered greatly from the lack of such roads when they were on the border last year.

A good road of this character a short way back would allow the troops to be considerably scattered but to be quickly concentrated at any desirable point.

I think the west coast is now being provided with roads of military importance. The topography of the

country practically settles where these roads have to be; north and south main roads have to run mainly in the valleys. Perhaps from a military point of view we need more laterals to connect them up, and some more concentric roads to enable an army to be maneuvered properly at likely points of attack.

Highways Supplement the Railroads

But there is another aspect of highway work in the war times. No doubt as our railroads are becoming congested and it will take considerable time before they are enlarged sufficiently to take care of the traffic, the highways will have to do more and more of the transportation of the country.

In some instances, the best that can be done may be to connect the rich farming community with its railroad center, having in view, of course, the possibility of a continuous through line later to connect with some other large center.

In other places the route or main line will be a through highway that will enable the large centers of manufacturing or those at which agricultural concerns are concentrated, to move their stores by motor truck whenever that becomes necessary.

Stronger Roads Necessary

We must realize the tremendous traffic that any road which is supplying an army or is near an army post must carry, and build the roads and bridges accordingly.

When we consider that a regiment of infantry today is 3600 men, and that a motor truck company has twenty-seven trucks, one wrecking car, and five motorcycles; that an infantry company has twenty-seven trucks and five motorcycles, or else twenty-eight teamsters with 112 draft mules, seven riding mules, and twenty-seven wagons to a company, you will readily see that a division which consists of six regiments, or three brigades of two regiments of infantry, one brigade of cavalry, one brigade of artillery, one regiment of engineers, and one battalion of signal corps, would make a very heavy amount of traffic on any highway that had to supply them.

Practically speaking, one division requires almost one road to itself. With all its equipment it would be nearly 15 miles, one day's march, long.

To move such a division by railroad requires 16 trains, 16 locomotives, about 104 sections, a total of something like 1500 railroad cars of various descriptions.

You must consider that each division has a brigade of artillery which consists of two regiments; each regiment has three batteries of four guns each, with six horses, and six caissons with six horses. These guns and caissons average about 3 tons each.

Each regiment of artillery is supplied by an ammunition train, and takes about ten ammunition wagons to each regiment of infantry.

With the heaviest guns used today it is probable that all of our bridges on the main lines or lines that might be used ought to be built to stand at least 15 to 17 tons. Some of the heavy guns now being made weigh 17 tons and have fully three-quarters of the load on the rear axle.

While these heavy loads must occasionally be carried, it is very likely in the future that the heaviest guns will have to be moved either on rails or on caterpillar tractors.

The main thing, therefore, that our roads must be made to stand is the continuous pound and wear of the 3- to 5-ton trucks and of the heavy wagons on iron tires with 4- to 6-in. wheels, the weight of which will not exceed, probably, 3 tons. Each of us in our own locality must see that we use materials, if possible, that are capable of withstanding this traffic.

Foundations Necessary

I think we should all pay a great deal more attention to the foundations of our roads than we have done in the past, when the traffic was lighter.

In my own state there is a tremendous commercial traffic in motor trucks. They are constantly on the increase. Most of our main roads have to carry 100 to 150 a day, and some of them have a much larger number. This is going to require stronger roads, thicker macadam, and a foundation in a great many places where the old macadam or gravel road would have held under the traffic of a few years ago without such foundations.

I think as soon as matters get a little more straightened out we shall have the active coöperation of the military authorities—at any rate, their support—in our endeavors to build the roads.

This has been shown already in Massachusetts. The Ayer cantonment, which has something over 30,000 men, was built about two miles from the railroad station on a fairly decent gravel road in a small and poor country town. The road was rapidly destroyed in a couple of months, and was becoming almost impassable.

Coöperation by the Military Authorities

The Highway Commission and the County of Middlesex are now coöperating with the government officials in building this road. We cannot build it as substantially as we would like, as we haven't time, but we are building a 6-in. bituminous macadam road, putting in the foundation where necessary and all necessary drainage.

The government officials are taking charge of this work under a percentage contract, and the state has agreed to pay one-half the cost, not to exceed $15,000, and the county has intimated that it will pay one-third of the cost, not exceeding $10,000.

The necessity of roads, from the military point of view, is shown again in the City of Quincy, Mass., where the government is constructing a large shipyard to turn out destroyers and other vessels. The existing highways were inadequate, as was the single line of street railway. Here the authorities in charge of building the yard for the government have decided to widen the road and put in two street railway tracks, the street railway company to repay the cost, and they are building from 15 to 17 ft. of bituminous macadam road on each side. They are widening the whole road to 60 ft., and the government is going to pay out of its funds, the whole cost of the highway widening.

The absolute necessity of good roads from a military point of view is already well recognized by the military authorities in this country, especially those who have had to do with the engineering and transportation departments or large bodies of troops.

I wrote to the War Department in Washington, asking what roads they considered of military value, how they should be built, etc., and received an answer dated Nov. 26, from Maj.-Gen. W. M. Black, Chief of Engineers, U. S. A., important parts of which are as follows:

The requirements of a military highway do not differ in any material respect from those of a highway for modern commercial purposes. The character of the roadbed should in general be the same as for a modern commercial highway, and in general a road designed for modern commercial purposes would serve well for military purposes. In practically all cases roads which are valuable in a military way are those connecting important commercial centers. Of course, there are some cases where roads interconnecting certain defensive works, or connecting such defensive works with neighboring commercial centers, are needed for strategic and other military purposes, but the number of such cases is small compared with the total length of roads useful for military purposes.

As to the question of what military roads must be prepared to carry in the way of traffic, it may be stated that our existing ordnance liable to accompany a field army will have its heaviest representative in a 12-in. howitzer weighing about 27,000 lb., 18,600 of which are on the front wheels and the remainder on the two hack wheels. The wheel base or distance between the front and rear axles is 18 ft.; width of track, 7 ft. 4 in.; width of tires, 8 in.; width of tire shoes, 12 in. This howitzer is to be drawn by a 75-hp. caterpillar tractor weighing about 25,000 lb. Comparison with the largest present-day commercial trucks shows that a road substantial enough for such will suffice for the ordnance load, so that in this particular as well as in a strategic way roads suitable for commercial purposes will meet the military requirements.

In short, it is the opinion of this office that any road that will serve for present-day commercial motor transportation will be satisfactory for prospective military traffic of all classes.

As you are probably aware, there were introduced at the last Congress two bills (Senate Bill No. 2470, by Senator Chamberlain, and House Bill No. 5165, by Representative Dent) which provided for a comprehensive system of military highways for the United States. It is believed that it is only in some such way as this that the problem of military highways will ever be satsifactorily solved, that is to consider the needs of the United States as a whole, to work out a project to meet such needs, and to complete such project in the order of the relative importance of the roads making up that project.

Major P. S. Bond, Corps of Engineers, U. S. A., says:

The motor car saved Verdun to France. But there is one highway in France which enjoys the same distinction. For three months, 24 hours a day, an endless procession of motor trucks, two abreast in each direction, traveled this highway going to and from Paris.

Without transportation an army is helpless, and transportation is impossible without suitable military roads. It is, therefore, essential that roads should be laid out and constructed with a view to military use as well as to the uses of peace, especially on frontiers most likely to be the scene of military operations. A little intelligent forethought and supervision by the Federal authorities would meet military needs with comparatively slight increase in expense.

It is of great importance also that there be no weak links in our distribution system. Troops and supplies will move both perpendicularly and parallel to the line of battle, and both cross and parallel roads should be paved. A section of unimproved road on an otherwise well-paved route might become impassable for large trucks, thus nullifying the military value of the entire stretch of road.

Good roads and railroads increase the useful productive capacity of our mines, fields and forests. Every road in every part of the land which connects a producer of any commodity with a shipper or consumer of that commodity will play its part in enabling the nation to bring to bear its full strength in armed conflict, and the better the road the more perfectly it plays its part. Therefore, every good road which is a necessary artery of supply or travel, as distinguished from purely pleasure routes, is an esential part of the system of national defense, even though it be not located in the theater of actual military operations.

A country-wide system of military roads, with a marginal highway around the entire country, will do much to solve the problem if it is properly prosecuted. Our splendid railroads will be of little use to us unless we complete our distribution system and are prepared with good trucks and good roads to distribute supplies to the points where they are needed.

The best and most comprehensive presentation that I have seen of this subject has been made lately by Maj.-Gen. Leonard Wood, U. S. A. What he says is much to the point and so practical that I cannot do better than to quote him as follows:

Of course, war demands a nation's entire resources, and the most efficient means of delivering them are needed. Thus a systematic well-planned network of roads which can be regularly used commercially is not only a good investment, but may be of tremendous value to our military forces. While hastily or improperly built roads should not be rushed at this time, on the chance that they might be of some strategic value to our armies, substantial highway construction of economic value should not be curtailed because we are at war. Through routes connecting centers of production, or population, aid in the prosecution of war by providing additional facilities for transportation of men and supplies.

There are also many roads, more especially along our coasts, the construction of which would probably not be warranted from the commercial standpoint, but which are a very real necessity in coast-defense plans. These, for example, might connect points of supply with selected points of defense, or enable the easy shifting and concentration of defending forces. Present roads are inadequate for such purposes in practically all coast states. It would be well to select the roads to be improved at this time after consultation with the War Department, and build those which have the greatest strategic value. It might frequently happen that a location which would make the highway a military asset would serve the community as well as another location which might be a military liability.

As a general rule, highways and highway bridges which are capable of sustaining modern commercial traffic will also stand under military loads. A bridge or road designed for the commonly used loading of a 17-ton road roller will be safe for practically all military loads and can be easily strengthened for the heaviest field guns now in use. Military plans are based on existing conditions and therefore field guns and their carriages are designed to be transported over the bridges and roads in the theater of operations. If heavier structures were the rule, larger guns would be forthcoming. At present the largest siege guns are transported in sections, the heaviest section weighing about 18 tons, most of which is on one axle, but distributed over a considerable area by means of "caterpillar" wheels.

Highway bridges to be of military value should, therefore, be designed for the heaviest commercial loading with a clear width of roadway of not less than 24 ft. and preferably 30 ft. From the military standpoint it is desirable that they should be (1) as nearly as possible of standard design, (2) difficult to put out of commission, (3) easy to strengthen, and (4) easy and quick to repair or replace in case of partial or total destruction. Structural steel, reinforced concrete and masonry are the only materials which answer these requirements, and at the same time have the permanence desired for this class of work. Structural steel fulfills the conditions named more completely than the others, but simplicity in design, using standard members and substantial construction, are prime requisites. The heavier the type of construction the more adaptable it is to any given military situation.

To be of value to armies in campaign, roads should be paved for a width of not less than 18 ft. and preferably 20 ft., and the total width between inside edges of ditches should be at least 30 ft. This will provide for two lines of motor trucks and allow a space on either side for the emergency repairs of broken-down vehicles, or the movement of troops. A shoulder width of 12 ft., either side of the pavement, would be very desirable, as this would give room for infantry marching without interfering with the use of the pavement for loaded vehicles. Low grades are, of course, very desirable. A grade of 3½%, if not too continuous, is without objection, and occasional short stretches of 5 to 6% grades can be negotiated without serious difficulty. Any steeper grade has a marked tendency to bunch and slow up traffic, requires lighter loading or more animals, and consequently reduces the capacity of the road.

The foundation for the paved road should be capable of carrying the loads mentioned above, and its depth of course depends on the material used, character of subsoil and

climate. It is apparently the tendency in this country to slight this part of the work in order to reduce costs. The speed as well as the weight of motor trucks demands the most painstaking and substantial construction. The foundation and substructures should receive the most careful attention, as they are liable to fail in bad weather or when neded in an emergency. Heavier foundations than are customary would not only be good military insurance, but also lengthen the life of the wearing surface under peace-time traffic.

The requirements of the wearing surface for military purposes may be stated as, (1) absolute dependence in all kinds of weather, in all seasons of the year, under the most severe usage, (2) wear resistent, so that extensive or frequent repairs or maintenance will not be necessary, (3) easy and quick to repair without interrupting traffic and with simple tools and materials, (4) low in tractive resistance, and (5) offering a good foothold for horses and a good grip for rubber tires, and at the same time smooth enough to allow a good rate of speed for motor trucks. Here again it is seen that military requirements coincide closely with industrial considerations. Only the highest types of standard pavement surfaces answer these requirements completely. Wearing surfaces which are not suitable for use in our cities will not stand up under concentrated highway traffic. The block pavements such as stone or vitrified brick are probably the best types, but in localities where these materials are not available carefully prepared sheet pavements of proven worth can be used satisfactorily. Methods of construction or types of surfacing which are used to cheapen the first cost at the expense of the requirements stated above should not be used. They are also proving uneconomical under modern commercial traffic.

The shoulders of a road paved for a width of 20 ft., being little used for traffic, may be lightly surfaced for a width of from 2 to 5 ft. on either side. The tractive resistance of this shouldering material should not be much greater than the pavement in order to avoid accidents when motors going at a high speed turn off the paved portion. In many localities oiled, rolled earth will answer; in others crushed rock must be used.

The construction of highways and highway bridges built by an army in the field would necessarily be governed by other considerations than those discussed. Timber would, for example, be used to a considerable extent in bridge building. The European armies, however, are giving dependability and permanence greater weight than formerly. Under war conditions only the highest type of construction can long withstand the strain.

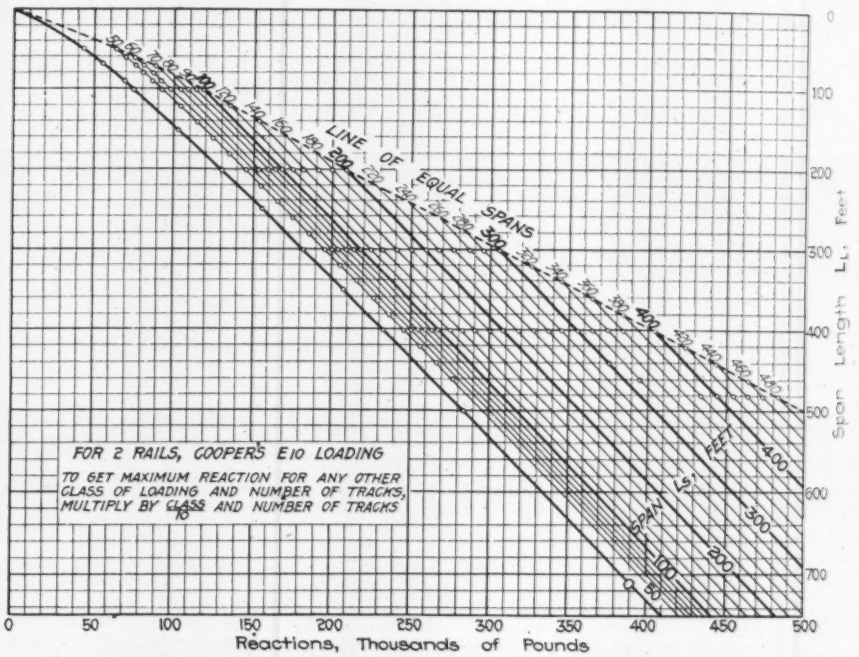
In conclusion, I would urge consideration of road construction paralleling our Eastern seaboard, particularly in those localities where important fortifications exist with no first-class connecting road. No one can foresee the outcome of the present crisis nor those crises which will follow. These matters of preparedness which cannot be handled over night should be considered well beforehand and provided for while we still have time and allies to defend us.

I think we should all confine ourselves to the building and maintaining of the roads that are really of the utmost importance to the military arm and to the country. We should not waste any effort on roads that are not of much importance. We should pledge ourselves to the utmost endeavor to this end, and I know the government will not find any body of men in the whole United States that will be more loyal and more active and more efficient than the Association of State Highway Officials.

Maximum Live-Load Pier Reactions for Railroad Bridges

By F. R. Sweeny, C.E.
Pittsburgh, Penn.

THE live load for which railroad bridge piers and abutments must be designed is determined from the heaviest type of locomotive to be used, by means of the criterion for maximum floor beam reaction. According to well-known formulas, the maximum reaction occurs when the two adjoining spans are loaded in direct proportion to their lengths. That is, if W_L represents the load on the longer span L_L, and W_S the load on the shorter span L_S, the maximum reaction at the pier occurs when $W_L/W_S = L_L/L_S$. With the aid of a moment diagram the proper wheel to be placed over the pier to produce this maximum reaction is located by trying several just to the right and then to the left until one is found which gives a ratio of W_L/W_S too large in one position and too small in the other. Occasionally several wheels will satisfy this criterion, and only by trial can the maximum condition be obtained.



MAXIMUM LIVE-LOAD PIER REACTIONS FOR RAILROAD BRIDGES

If different combinations of span lengths are taken and the maximum reaction worked out for each case, the results may be reduced to the simple diagram shown, in which the inclined lines represent the shorter span and the ordinates the longer. On the horizontal axis, just below the intersection of these two lines, will be found the maximum reaction in thousands of pounds. This diagram is worked out for two rails of Cooper's Class E10 loading. To determine the load for any other class and any number of tracks, multiply the values given in the diagram by the ratio of the class in question to 10 and then by the number of tracks.

At the upper end of the diagram, where relatively short spans are involved, the effect of the concentrations is to curve the lines slightly, but in the longer

spans a large portion of the load is uniform and the lines are almost straight.

The diagram may be reduced to the following very convenient formulas, which will give results accurately enough for designing purposes. For Ls between 50 and 100 ft., the maximum reaction

$$R = \left(\frac{L_L + Ls}{2} + 20\right)\frac{class}{10} \times N$$

For Ls one hundred feet and over

$$R = \left(\frac{L_L + Ls}{2} + \frac{1900}{Ls}\right)\frac{class}{10} \times N$$

where N is the number of tracks.

The maximum reaction for abutments will be found on the diagram where $Ls = 0$. This may also be reduced to approximate formulas. Where L is between 50 and 100 ft.

$$R = \left(\frac{L}{2} + 20\right)\frac{class}{10} \times N$$

For L over one hundred feet.

$$R = \left(\frac{L}{2} + 30\right)\frac{class}{10} \times N$$

All reactions found by the above formulas are in thousands of pounds.

Car Shortage and Its Relation to Highway Work

Extracts from an Address Before the American Association of State Highway Officials at Richmond, Va., Dec. 4

By Charles M. Upham
Chief Engineer, Delaware Highway Department

IN DISCUSSING the subject of "Car Shortage, Its Present Condition and the Remedy," let it be understood that this convention is not discussing this subject to see if there is a possible way to get around or overcome any of the priority orders, nor to criticize or hamper in any way the decisions of the Council of National Defense. The purpose is to draw forth in discussion any points that may lead to a situation or condition so that highway work can continue; so that highway work can be taken out of the class of non-essentials and not be grouped with theaters and musical instruments, and that Priority Order No. 2 can be so modified that open-top equipment can be used for the delivery of materials in the construction of certain highways, at least.

Inadequacy of Freight Rates

In order to discuss these conditions on a solid foundation, it seems to me that it is time well spent to review the conditions during the past few years and to state a few of the things that have been done to relieve the present conditions. In 1912 or 1913 the railroads asked for an advance in freight rates of approximately 15%. This increase, they pointed out, could be utilized for new equipment, additional track, new terminals, etc. They received about 5%. This led the railroads to economize and make fewer big improvements. The depression of 1914 was then about to make matters worse for the railroads, and in April, 1915, conditions were such that the records show that there was an excess of 327,000 idle freight cars, and that at no time since 1908, with the exception of a very few months, was there an excess in unfilled car requisitions; the idle cars numbered from 7000 to 400,000 during this period. Surely this did not indicate the necessity of new car equipment or new rail equipment, or new terminals.

In August, 1914, the war commenced, and during the latter part of the year 1915 congestion in certain districts started. The excess of idle cars quickly diminished until September, 1916, when the scarcity of freight cars began to be felt. These conditions grew rapidly worse until May, 1917, when the unfilled car requisitions totaled 148,000. By coöperation and efficiency this situation was temporarily overcome and conditions were bettered, so that in September, 1917, the unfilled car requisitions were reduced to 34,000. The activities of the past few months and the great increase in volume of production have overcome the gain made by the efficiency, and once again the total of unfilled car requisitions is increasing, and we have not yet reached the maximum demands.

When asked, "Why the present conditions?" one person says, "Not enough cars," the next person, "Not satisfactory terminals," and the next, "Not sufficient tracks," and still others assert, "It is the motive power," and if the truth were known, the chances are they are all correct. Would a reply, "Not sufficient improved highways," be incorrect?

Reasons for Shortage

The reasons for the present car shortage and freight congestion can be summed up as follows:

The present railroad equipment, which has remained virtually constant for two or three years, is now asked to handle an amount of freight that has greatly increased in volume over normal conditions, and is still increasing. The situation has come to such a state that it is very probable that it will be impossible for the carriers to handle all the traffic that is offered during the coming winter. During the first five months of our entry into the war, our railroads handled more freight than in the corresponding months of 1916, which year broke all records. The traffic handled in these five months exceeded the total traffic moved in any entire year prior to 1904.

In six months, May to October, 1917, 18% more coal was moved than in the corresponding months in 1916. About 116,000 carloads of freight have been hauled to the camps, and up to date 17,000 carloads of freight have been handled for the Shipping Board. Approximately 75,000 carloads of supplies each month are being moved to the camps. This year the railroads have hauled the largest passenger business ever known, besides transporting over a million soldiers to the camps. These movements in themselves do not mean so much, but they have complicated matters and increased the difficulty of moving freight traffic. All of these increased demands have been met while the railroads have virtually the same facilities as they had two years ago.

Much has been done to overcome the present situation or car shortage, but probably the greatest factors are the "pooling" of all freight cars and later of the entire equipment east of Chicago.

One of the many things that has assisted toward overcoming the present car shortage has been the intensive loading of cars. It is only recently that railroads have loaded their freight cars to marked capacity. The carriers are now asking that all heavy commodities be loaded to 10% in excess of the marked capacity of the cars, and that all light-weight or bulky freight should be loaded to the full cubical capacity. The car service committee informs us that for every ton increase in the average load per freight car for all the equipment of the United States an additional 100,000 cars are made available.

It has been found that the average time consumed by shippers in loading and unloading freight is about two days. This indicates that the shippers generally plan not to release equipment until expiration of the free time allowed. Any reduction in the time of loading or unloading of freight will make available a large number of cars and will assist materially in overcoming the present want of equipment.

At present there is a shortage of many thousands of freight cars and this will increase during the winter months and bring acute conditions unless every shipper loads to capacity and every consignee unloads cars immediately. Such has been the coöperation since the war began that the railroads have been able to move approximately 25% more freight than in the same period last year.

Highway as a Means of Relief

Even with all that is being done, with the close cooperation between railroad and shipper, the maximum efficiency of the railroads will soon be reached. Our canal and waterway systems, very valuable assets, are not sufficiently developed to take much of the freight. Electric railways can help, but the great increase must be transported over the highways.

Just how can the highway be economically utilized? It is doubtful if there would result a saving by sending a truck on very long journeys, even over good highways. While I have not the figures at hand, it would seem to me to be possible to send trucks on journeys of one day, or a day and a night, up to 200 miles, on good highways. Many of our largest cities in the congested districts are located so that trucks picking up freight one day can deliver it in another city during the next day. If trucks were used for all freight between near-by cities, this would relieve thousands of cars for "long hauls," and also prevent congestion at over-burdened terminals. If our truck lines were developed they could take care of l. c. l. freight within certain zones and release thousands of cars. One instance I know of is where a small safe was the only piece in the car. This could have been handled by truck and thus made one more car available for longer distance freight.

Already freight trucks are operating to a small extent between cities. The present freight congestion can be greatly remedied by increasing this kind of traffic. This will mean, however, the proper maintenance, and in some cases, the construction of highways.

In such a time as this the construction of highway work should not be carried on as it has been formerly. In some sections that cannot be called essential, traffic and freight have been bumping over poorly constructed or non-improved highways for years and years. The construction at this time of these roads could not be called essential, though no doubt it would be beneficial. In other places traffic has been bumping over roads that have been poorly maintained. It would not seem that they should be repaired just at this time. But there are roads that are located in such a way as to have an economic and military importance. [The reader is referred to a paper on "Military and Other Highways in War Time," elsewhere in this issue.—Editor.]

All state highway officials should make a list of roads the construction and maintenance of which they deem of economic or military importance, giving their reasons for each case. They should also estimate the number of cars needed for the construction or maintenance of these roads and the time that these cars should be needed. Then a committee should be appointed to confer with the Highways Transport Committee, which would take up the matter with the proper authorities and inform the highway officials how many cars will be available for highway service. In this way a coöperative program could be outlined and the more essential highway work be continued.

Burn Sewage Gas to Eliminate Odor

Gases arising from the three Imhoff tanks at Rock Hill, S. C., created so great a nuisance that they have been collected in improvised gas-holders over the gas slots and then burned. J. G. Barnwell, city manager, in reciting the experience of the city at the recent City Managers' convention, stated that the city had suits pending against it aggregating $200,000 and others threatened, bringing the amount to $500,000. The allegations were on three counts: Stream pollution, discoloring stream and smell from works.

Experts have studied the situation, and as a result the pollution is remedied by chlorination. Experiments indicated that chlorine, acting as a bleach, would also eliminate the color if used at mills, which were compelled to treat 4000 gal. of wastes daily at a cost of 15c. per 1000 gallons.

The gases from the Imhoff tank were found to be methane and sulphuretted hydrogen. They were given off in the sludge, which foamed badly. Finally, it was concluded to build up the sides of the 2 x 23-ft. gas slot one foot higher and erect a gas-holder arrangement.

A flame 6 in. long consumed continuously 2 cu.ft. per hour, thus eradicating the odor nuisance.

In discussion, O. E. Carr remarked that at Niagara Falls, where many chemicals are made, the difficulty is to keep the chlorine, naphtha, etc., out of the water and sewage. The problem has not been solved, but put up to the manufacturers. Two naphtha explosions in sewers have occurred already, in a carbide factory.

A member of the City Managers' Association recounted an experience with a woolen mill in a case where similar suits were brought. The Imhoff tanks and filters could not handle the domestic and mill waste on account of lint clogging the filters. An arrangement has now been made by which the mill stores its 65,000 gal. of waste until night, when this is sent to a special ¾-acre filter bed of its own. Treated separately, both sewages can be handled successfully. Incidentally, a pitometer survey had recently reduced the water consumption from 1,000,000 to 660,000 gal. daily.

Mechanical Plant Largely Used in Pennsylvania Road Maintenance

Labor Difficult to Hold During Past Season—Great Increase in Use of Roads by Motor Trucks—Embargo Halts Work

By George H. Biles

Second Deputy State Highway Commissioner of Pennsylvania

IN PRESENTING the problems of road maintenance work in Pennsylvania this résumé is given with the single thought of enumerating the facts briefly, rather than of attempting any detailed elaboration of the difficulties and obstacles we have encountered during the past season's work and of describing measures to which we have resorted in order to accomplish results under what can be truly called abnormal conditions. Pennsylvania acquired a system of highways comprising approximately 10,200 miles, composed of various types of improved and unimproved roads. The latter approximated 80% of the total mileage, which, under the law describing this system, specified that they should all be taken over for maintenance and construction by the State Highway Department. It is doubtful if any other state has approached the road question in this way, the general practice being only to take roads under control for maintenance after they have been built or reconstructed.

This system of state highways is augmented by approximately 400 miles of state-aid roads which are maintained jointly by the state and the township or borough, each paying 50% of the cost. The state, however, performs the actual work and finances it, and after proper certification of cost, it is reimbursed by the township or borough.

The maintenance and repair of our highways are financed from the revenues derived from auto license fees which, for the present year, will reach about $3,270,000. This anticipated fund was budgeted at the first of the year to the various classifications of the work, such as resurfacing, oiling, general repairs, etc., and upon estimates received from the several district engineers, authorizations were issued with which the work under each engineer was prosecuted. After the authorizations had been issued, estimates were requested for materials which had to be purchased, such as stone, sand, gravel, stone chips, dynamite, fuse, caps, culvert pipe, bituminous materials, etc., and from these estimates bidding schedules were prepared and advertised for contract. When the contracts were awarded, preparations were begun at once to take care of the deliveries so that when the season for work arrived material should be on hand and the usual delays in receiving materials should be eliminated.

Mechanical Devices Largely Used

Realizing that the labor situation would be tense, we installed mechanical devices for unloading the larger shipments of stone, gravel and stone chips, and engaged numerous motor trucks, in addition to those owned by the department, to insure quick deliveries. On the unimproved roads the road machines or graders were started early, and these roads were put in good condition in the early summer, which is most essential in earth road maintenance. Organizations of men and equipment were started where partial deliveries of materials had been made, but we had not progressed far when the effect of the abnormal conditions were becoming apparent. The contractors furnishing our materials were affected in their car supply by the diversion of cars to shippers of coal and other materials used in the fabrication of war supplies. Companies requestioning 25 cars daily received between four and seven, and in most cases these were flat bottom cars.

Under such conditions unloading devices had to be abandoned on account of the inability to secure the hopper-bottom cars, and the delays thus occasioned affected the work to such an extent that considerable loss and expense were sustained, and the original organizations were disrupted before the work was nearly completed. This condition was true more particularly on the main heavily traveled roads, which were subjected to added traffic under the new conditions. Various embargoes were established, and in some sections it is utterly impossible today to get shipments of materials to accomplish the urgent repair work on the highways.

Labor Difficult to Hold

These conditions naturally had their effect on what little local labor there was left, which it was quite difficult to hold on account of the uncertainty of employment. A fair percentage of increase in rates was looked for and considered when estimates were prepared, but in some cases they had advanced 100%, annulling entirely all previous calculations. There has been such a dearth of suitable labor that rates were not by any means the only consideration.

Damage from flood, cloud-burst and other catastrophe has been greater during this season's work than ever before in the history of the department. Many miles of earth road have been rebuilt and worked on this account as many as five times, each succeeding working adding to the difficulty, for as the season advanced there was less opportunity for the earth road to compact and become as solid as is possible when worked in the early part of the year.

The legislature, which adjourned in June, changed the location of approximately 100 miles of state highways,

ROAD-BUILDING EQUIPMENT USED BY PENNSYLVANIA HIGHWAY DEPARTMENT THIS SEASON

Equipment Owned by State Highway Department		Rented Equipment	
Bituminous plant	1	Cars (dump)	9
Bins (stone)	2	Crushers	26
Cars (dump)	12	Drills (steam)	6
Carts (dump)	10	Mixers (concrete)	10
Crushers	26	Machines (road)	128
Derrick	1	Plows (rooter)	5
Drills (steam)	14	Pumps (gasoline)	22
Engine and boiler	21	Pump (steam)	1
Forge	22	Rollers	89
Heaters (surface)	5	Scarifier	1
House (portable)	1	Sprinklers	49
Kettles (asphalt)	14	Sweepers (street)	9
Mixers (concrete)	5	Tanks (storage)	6
Machines (road)	214	Trucks	203
Plows (road)	87	Wagons (dump)	58
Plows (rooter)	71	Automobiles	88
Pumps (gasoline)	31	Engines (traction)	88
Pumps (steam)	1	Shovels (steam)	2
Rollers	42	Saw rig, complete	1
Scarifiers	24	5 H.P.	
Sprinklers	51	Stove (cook)	1
Sweepers (street)	30	Scoop (drag)	1
Spreaders (chip)	36	Hoisting crane	1
Tanks (storage)	12	Track, 1,500 ft.	
Tents	46		
Trucks (motor)	11		
Distributors (oil)	2		
Unloading outfits	7		
Wagons (dump)	122		
Wagon (truck)	1		
Wagon (fire)	1		

WORK ACCOMPLISHED TO DATE

General Repair

Type of Road	Miles Completed
Earth	6,028 283
Gravel	192 905
Flint	115 777
Waterbound macadam	1,999 076
Asphaltic bituminous macadam	143 319
Asphaltic concrete	83 610
Brick	54 071
Concrete	13 619
Total	8,630 660

Resurfacing

Type of Road	Miles Completed
Gravel	4 536
Stone	41 387
Waterbound macadam	130 417
Asphaltic bituminous macadam	0 796
Total	177 138

Oiling

Class of Oil	Gallons Applied	Miles Completed
"C"	3,287,331	1,073 383
"D"	1,037,500	395 508
Total	4,324,831	1,468 891

Bridge Construction

Type of Road	Number Completed
Standard reinforced concrete	2
Box—reinforced	2
Total	4

and this, with the acquisition of 69 miles of old turnpikes or toll roads (which action could not be anticipated in the beginning of the year), added to the difficulties of financing the work.

Motor Truck Traffic Heavy

Excessive use of the highways has been marked, on account of the transportation of innumerable articles by means of motor trucks and horse-drawn vehicles in lieu of the railroads. These conditions were more pronounced in the soft-coal counties of the state, where small mines were opened and the products hauled in all kinds of conveyances to some nearby city or railroad point. Continuous trains of such vehicles traveled night and day and the roads, especially the unimproved ones, were unable to withstand the effect of such use. Special effort is being made, where it is impossible to secure suitable material, to cover the worst portions of these roads with cinder, slag, gravel, shale or some other coarse and satisfactory material, keeping it as smooth as possible by continuous dragging, which method will be followed until the road freezes up hard and smooth. This method will be resumed again, whenever practicable, after every thaw.

In order to cope with the problems thus presented, where shippers had contracts for the delivery of material to several destinations, orders were issued to concentrate on certain projects in the order of their importance. Organizations and equipments from work which had to be held in abeyance were transferred to points of urgency and also to locations where local material was available for the work as planned. Mechanical devices have been used wherever possible; stone and gravel mechanical spreaders were used where practicable and man power assigned to forms of work in which the use of machinery was not feasible. Small, two-horse grading machines took the place of much of the hand labor in shoulder work along the improved stretches of road.

TYPE AND LENGTH OF THE SEVERAL CLASSES OF ROADS

Type	Length, Miles
Earth	6,693 573
Gravel	232 940
Flint	103 460
Stone block	3 111
Water bound macadam	2,465 001
Asp. bit. macadam	208 610
Asp. concrete	142 299
Concrete	38 212
Brick	302 556
Toll	379 459
Bridges	7 428
Wood block	228
Asphalt block	194

Motor-driven vehicles were used when possible and expedient in transporting labor from one point to another, and in some instances crews have been transferred 30 or 40 miles at a single change. This transportation was made by small auto busses and touring cars carrying 5 to 8 men and was paid for on the mileage basis, in no case exceeding a rate of 10c. per mile for the entire crew. These groups of workmen acted as flying squadrons which were the only possible means of getting the necessary work done. At the period of maximum activity approximately 11,000 men were employed and the equipment listed in the accompanying table was used.

The priority order of the United States Government is the paramount problem which confronts us today. Aside from the necessity of closing down all our work dependent upon railroad shipments, it will be quite difficult to forecast the possible effect of this order on the future until the survey of conditions now under way is completed and analyzed; but on the face of affairs, it would appear that we are approaching an unparalleled era in the prosecution of road work in general, and, except where materials suitable for maintenance work are easy of access, no extensive work can be undertaken. Activities should be directed mostly to the important arteries of travel and the less important roads kept in as good a condition as possible, with the means at hand, until the crisis is past.

Automatic Lights Aid Lake Navigation

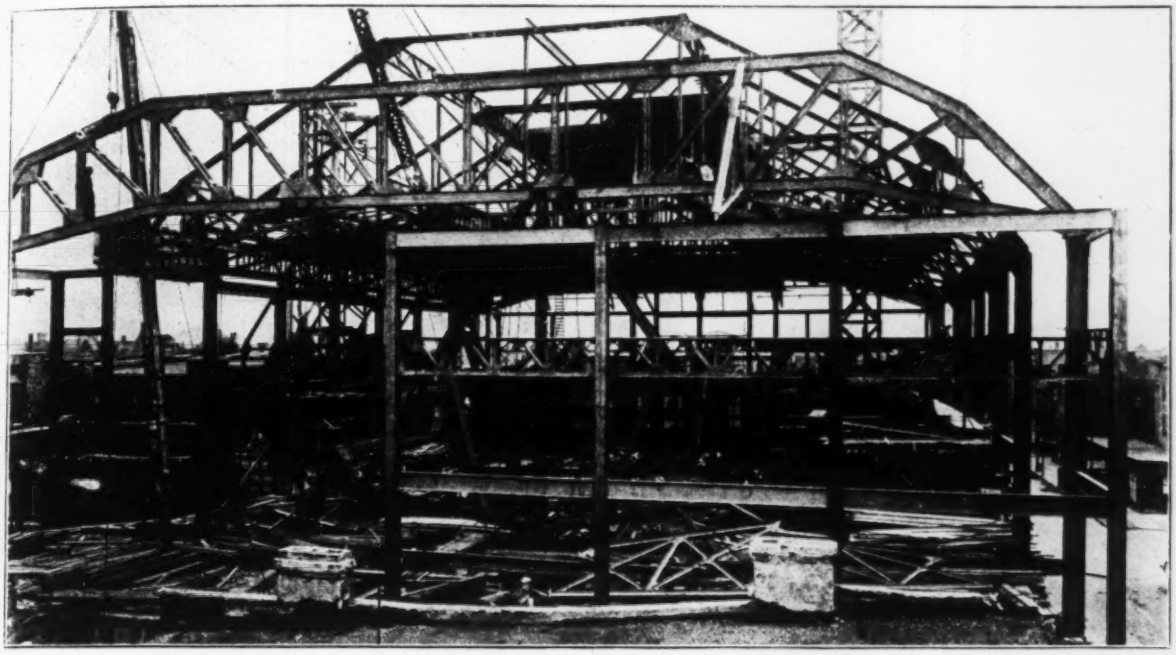
Long-burning lamps, lighted and extinguished automatically according to changes in atmospheric light, are used on the beacons and gas-buoys for the guidance of vessels in the Livingstone channel of the Detroit River. The fixed beacons burn acetylene gas, and the buoys burn oil gas. Each lamp is provided with a regulator and flashing chamber, and a pilot light which burns continuously.

Automatic control of the main light is provided by a sun valve, which shuts off the gas during the daylight period and turns it on at dusk. This valve is operated by utilizing the difference in light-absorbing power of bright and dark surfaces, with the consequent difference in heat-absorption and expansion of these surfaces. The apparatus consists of three bright rods placed around one black rod. The acetylene lamps will burn for more than 100 days with one set of tanks, and the oil-gas lamps will burn about 90 days without the buoy being recharged.

The American Gas-Accumulator Co., of Elizabeth, N. J., and the Safety Car Heating & Lighting Co., of New York, were contractors for the acetylene-gas and oil-gas apparatus, respectively. Plans for the lighting of the channel were prepared by Charles A. Park, superintendent of the 11th Lighthouse District, and the work was under the direction of Edward L. Woodruff, lighthouse inspector of that district.

Steel-Frame Hall Forms Top Story of Concrete Building

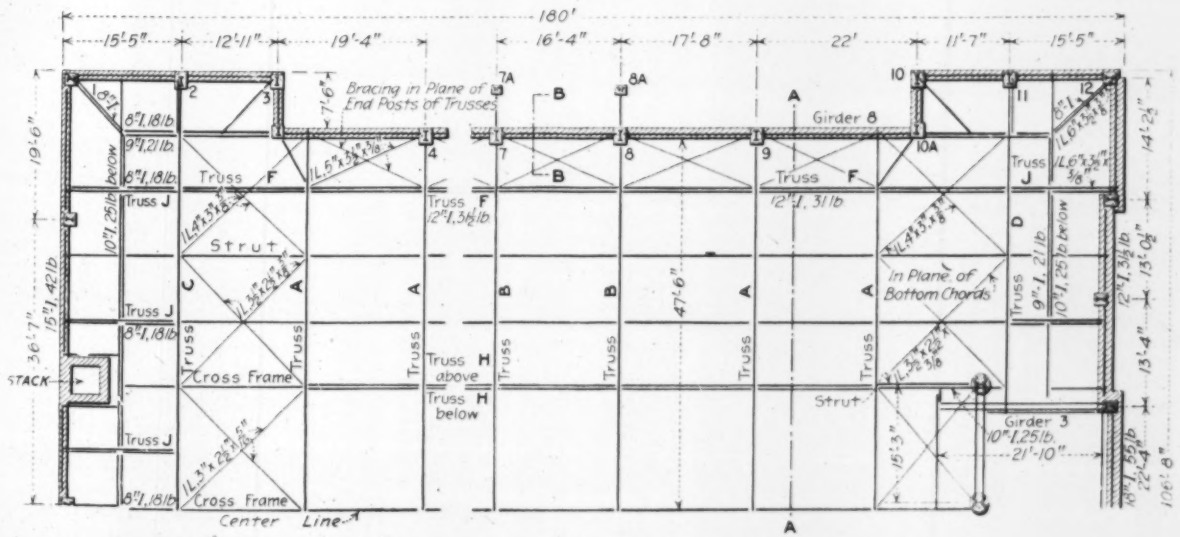
Long Span Steel Trusses Carried on Tall Steel Columns Seated on Concrete Columns of Main Building Below—Special Form of Monitor Roof Used



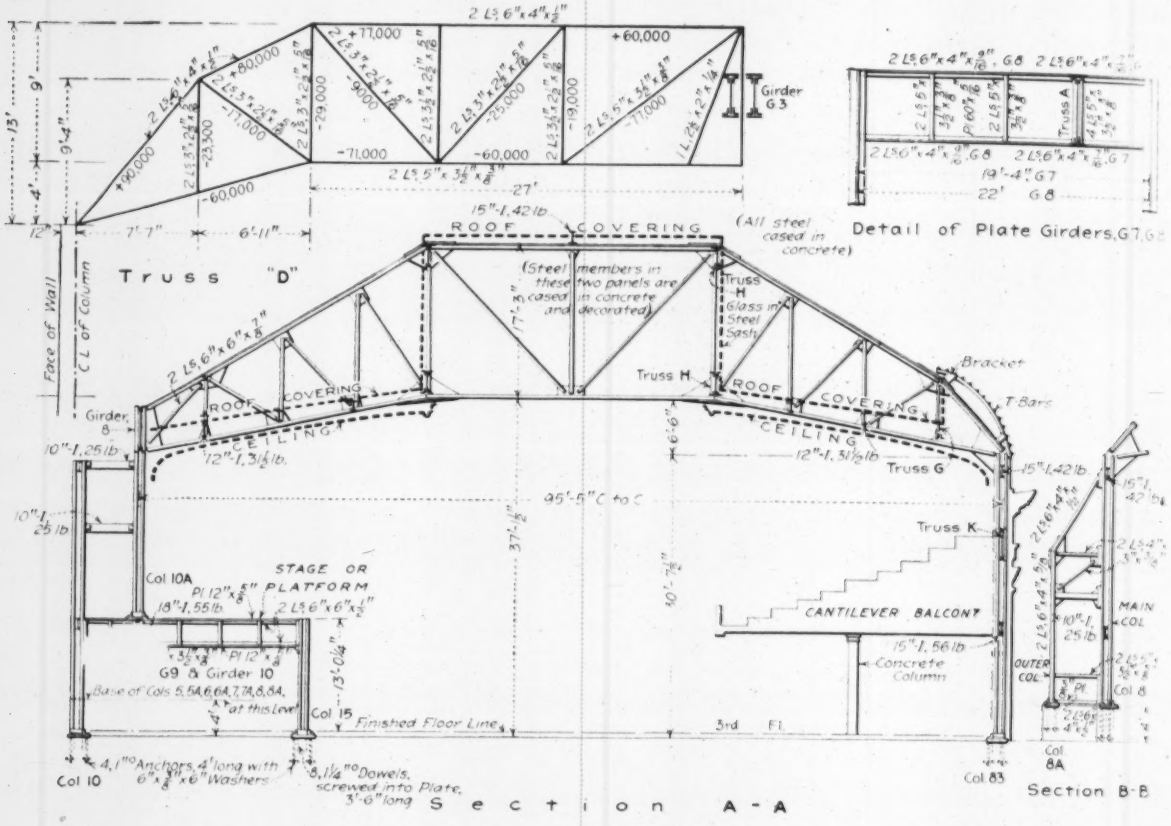
ERECTING STEEL ROOF TRUSSES FOR HALL ON TOP OF A THREE-STORY REINFORCED-CONCRETE BUILDING

STEEL structural framing for an assembly hall at the top of a reinforced-concrete building recently erected in Chicago was adopted on account of the necessity of providing a large clear floor space in the hall and on account of the economy of the lighter steelwork over concrete for the long spans. Steel roof trusses of 95 ft. to 104 ft. span are carried on tall steel columns. A wide inclined balcony of reinforced concrete is carried on inclined cantilever girders whose upper ends are supported by the steel framing between the colmuns. The structure will be the headquarters of the Amalgamated Association of Street and Electric Railway Employees of America. It is located on Ashland Ave. at Van Buren Street.

The building is 180 x 106 ft. in plan and has three stories and basement, with stores on the first floor and offices and lodge rooms above. The reinforced-concrete construction includes these two floors and the floors of



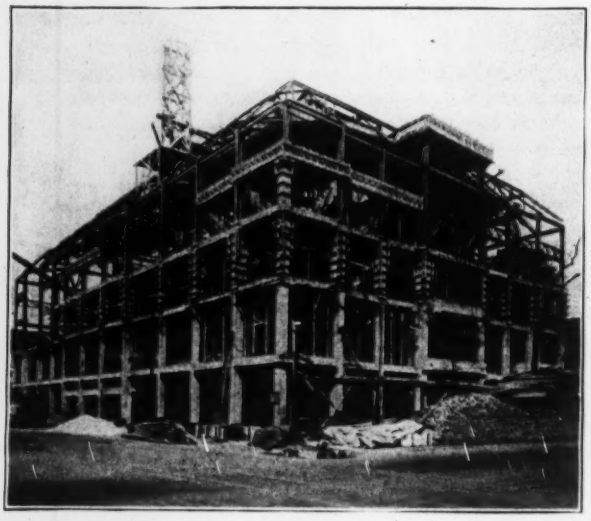
PART PLAN OF STEEL FRAMING OF ASSEMBLY HALL



CROSS-SECTION OF ASSEMBLY HALL, SHOWING ROOF ARRANGEMENT ON TRUSSES

the assembly hall. It has square columns, with a main spacing of 16 x 16 ft., carrying three flat-slab floors. The slabs are 9 in. thick on the first and third floors, and 8 in. on the second floor. The assumed live loads are 100 lb. for the first and third floors, and 50 lb. for the second floor.

Steel trusses 95 ft. 5 in. and 96 ft. 9 in. c. to c. of bearings span the top floor. They are carried by high steel columns, and with a camber of 6 ft. 6 in. in the bottom chords they give a maximum headway of about 37 ft. The trusses and columns form an integral structure, the ends of the chord members being riveted to large connection plates on the tops of the columns. An unusual form of roof is obtained by forming a monitor or clerestory roof within the depth of the truss. This includes the two middle panels, and has vertical sides of ornamental glass in steel sash. The roofing is laid along the top chord in these middle panels, and along the bottom chord in the side panels of the truss.



THREE-STORY REINFORCED-CONCRETE BUILDING IS SURMOUNTED BY STEEL-FRAME HALL. STEEL IS BEING CASED WITH CONCRETE. THE INCLINED CONCRETE GIRDERS CARRY THE BALCONY

This arrangement leaves the ends of the trusses exposed above the roof, but they are concealed from view from the street by a cornice and a curved line of ornamental tiling which gives the appearance of a mansard roof. The exposed portions of the trusses are fireproofed and weatherproofed by incasing them in concrete.

In the main trusses all the members are pairs of angles forming a T-section with a cover-plate on top of the top chord. At the front of the building the interior architectural design made it necessary to omit the middle panels of the first truss. This truss, shown in the drawing as truss *D*, consists therefore of two 41-ft. side trusses having their inner ends framed against box girders supported on wall columns and interior columns. These girders carry a reinforced-concrete clock tower.

The last truss at the rear of the building (truss *C* in the drawing) is of much heavier construction than the others, as its span is increased to 104 ft. 3 in., while

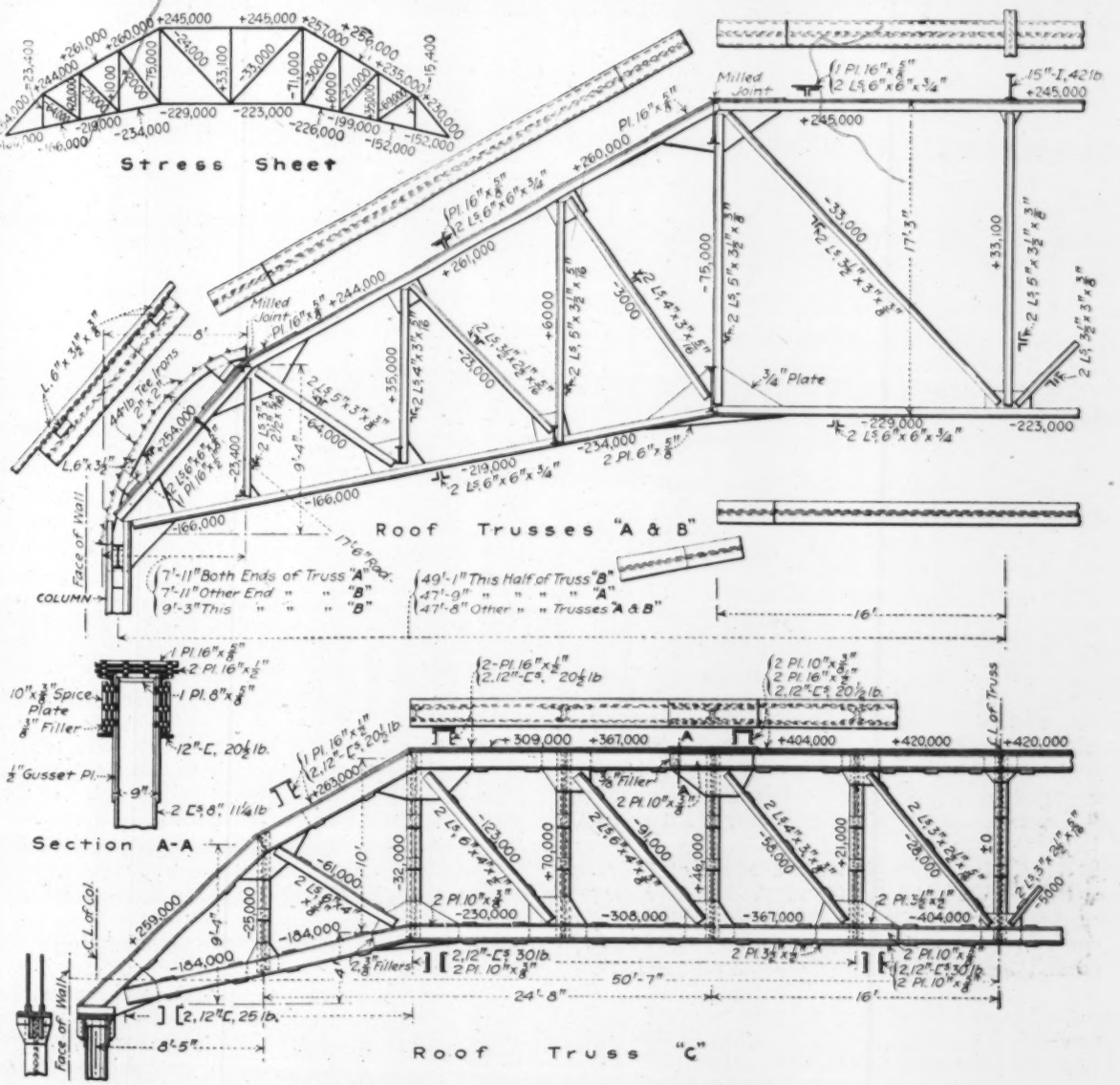
its depth is limited to 10 ft. instead of 17 ft. 3 in. as in the shorter spans. In this truss the chords are pairs of channels with reinforcing plates on the webs, and batten plates across the flanges. Cover plates are used on the top chord. The verticals are composed of pairs of channels, and the diagonals are pairs of angles. This truss is unsymmetrical, having an extra panel at one end, so that it is 55 ft. 2 in. long on one side of the center line and 49 ft. 1 in. on the other side.

The spacing between the trusses ranges from 16 ft. 2 in. to 17 ft. 8 in. Longitudinal bracing is provided by lines of I-beams and lattice girders framed between the vertical members of the trusses, and there is also diagonal bracing in the planes of the end posts. The two trusses at each end are connected in pairs by struts and vertical cross frames, and by diagonal bracing in every panel at the plane of the bottom chords. At the ends of the building the roof is covered by short trusses extending from the main trusses to the walls.

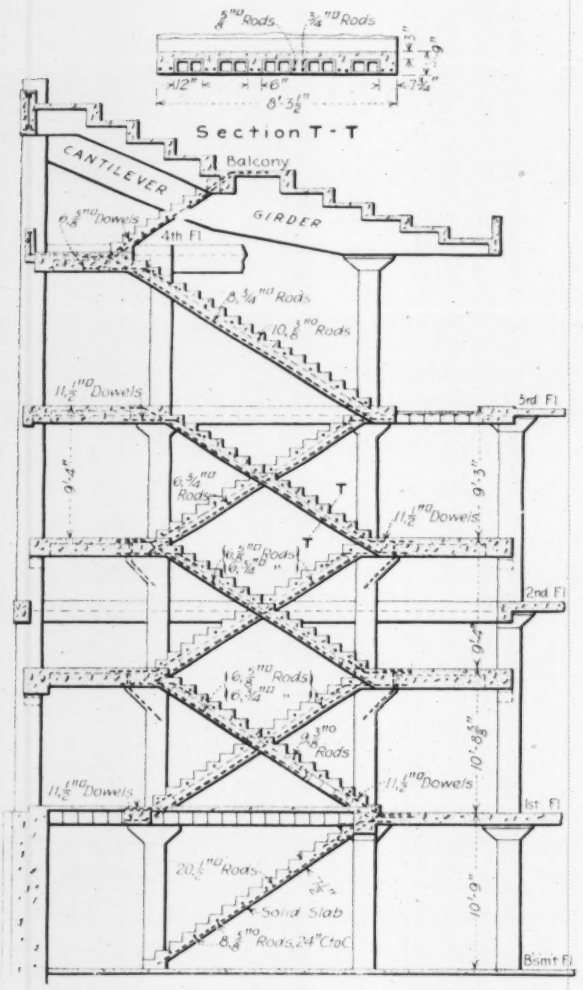
The flat portions of the roof have a tile and concrete joist covering, carried by a frame work of I-beams. The end posts of the trusses have curved channels attached to brackets and carrying lines of T-bars for the book-tile covering which receives the ornamental tile concealing the exposed ends of the trusses. The roof is designed for a wind load of 30 lb., and a snow load of 20 lb. per sq.ft. of exposed surface.

Owing to the height required for a hall of this kind the steel columns supporting the roof trusses are about 30 ft. 6 in. high. They are connected longitudinally by lines of I-beams and lattice trusses framed between their webs. The columns are of H-section, each composed of a web plate and four angles. Their shoes, at the third floor level, are anchored to the tops of the reinforced-concrete columns of the lower part of the building.

Unsymmetrical column spacing on one side necessitates carrying two of the roof trusses with one end seated on a longitudinal truss between the tops of adjacent columns. Near the middle of the building, on



DETAILS OF MAIN TRUSSES FOR ASSEMBLY HALL



REINFORCED-CONCRETE STAIRS AND BALCONY FOR STEEL-FRAME ASSEMBLY HALL

the opposite side, the width is increased, and the outer wall supports supplementary steel columns which are composed of pairs of angles and are tied to the main columns. The narrow space between the inner and outer columns is used for stairways.

A wide balcony extending along one side and both ends of the hall is carried by inclined reinforced-concrete cantilever girders. The girders are 32 ft. long, and have the upper end carried by the horizontal steel framing between the columns, while near the lower end of each is an interior concrete column, leaving a cantilever projection of 16 ft. The concrete floor of this balcony has the upper face formed in steps for the rows of seats. It is designed for a live load of 100 lb. per sq.ft. On the opposite side of the hall is a stage or speaker's platform, having a frame of steel girders and columns. The main floor has a clear width of 78 ft. between the columns of the gallery and platform.

Two double-stairways of X-shape are provided for exit from the hall. Each is about 18 ft. wide, with two lines of 8½-ft. stairs in opposite directions, as shown in one of the drawings. The idea is that two 8-ft. stairways with separated entrances are safer and give greater capacity for handling crowds than a single wide stairway. Each 8-ft. stairway is also subdivided by a central railing which divides the crowd and provides an additional hand hold to supplement the hand-rails on each side. The stairs are designed for 100 lb. live-load.

The landings are 16-in. slabs, midway between the floor levels. Both stairs and landings are of concrete slab-and-joist construction, with tile filling between the joists. Solid slabs, however, are used for the basement flights. The stairs are finished with mastic safety treads and cast iron nosing.

The Francis M. Barton Co. is architect for the building, and also designed the structural steel framing for the hall. The reinforced-concrete work was designed by the Barton Spider-Web System Co. The contractors were the Wieboldt Construction Co. for the concrete and masonry, and Wendnagel & Co. for the structural steel.

Circular Reservoir Floor Built in Concentric Rings

Reinforced-Concrete Slabs Arch Between Circular Shoulders Which Also Support Timber Roof Columns

By Carl E. Hasse
Santa Monica, Calif.

A 1,500,000-gal. reservoir recently completed for the City of Santa Monica, Calif., is in effect a circular tank, 130 ft. in diameter and 15 ft. deep, with reinforced-concrete walls, with a timber roof supported on timber posts and a concrete floor which furnishes the main novelty of the design. This floor is composed of annular rings of reinforced-concrete slabs footing on circular sills which also carry the roof posts.

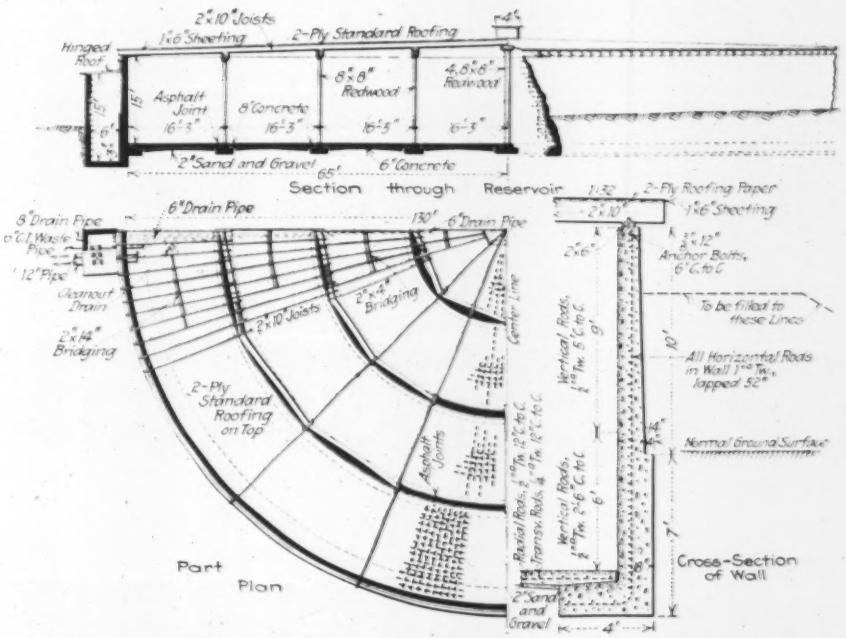
Approval of a bond issue in an election in the spring of 1916 enabled the city to purchase the four private water companies which had been serving the city and some adjoining territory, and the subsequent consolidation and organization into one system included meterings, extensions and increased storage capacity. The reservoir of one of the smaller companies was so inadequate that the building of a new reservoir of sufficient capacity was deemed an immediate necessity. The old reservoir was an earth excavation with sloping sides and flat bottom, lined with concrete.

The new reservoir is shown in the accompanying drawings. In plan the floor is laid in the form of four concentric rings, each 15 ft. in width. The edges of the slabs are separated from the piers by a 1-in. asphaltum-filled, hot-poured joint. The slabs are 6-in. thick at the center and 8 in. at the piers, and rest on a cushion of well tamped sand and gravel. They are reinforced with ½ in. square rods radially and with ¼-in. rods longitudinally, both sets being spaced 12 in. on centers. No particular care was taken to smooth the surfaces of the shoulders of the piers before the slabs were poured.

The outside walls, also of reinforced concrete, are vertical on the inside. The top width is 10 in., thickening to 14 in. at a point 10 ft. below the top, and below this point the walls have a uniform thickness of 18 in. The walls are reinforced horizontally with 1 in. square

rods spaced as shown in the accompanying drawing, and vertically with ½ in. square rods of varying lengths spaced 2 ft. 6 in. on centers. A backing of earth fill extends about two-thirds the height of the wall.

The roof consists of two-ply roofing paper laid on 1 x 6-in. sheathing nailed to 2 x 10-in. redwood tarred joists arranged radially and spaced 30 in. at the outer wall. The joists rest on 8 x 8-in. redwood caps on the intermediate posts and on 2 x 6-in. plates on the wall. The spaces between the joists at the wall are covered tightly with ordinary galvanized window screening. The original plans called for 3-in. galvanized pipe posts for the roof supports, but 8 x 8-in. tarred redwood was substituted, thereby effecting a saving of about $250. The original central post was of reinforced concrete, circular in section. In its place are four 8 x 8-in. tarred redwood posts set at the corners of the 4-ft. square concrete base.



NEW RESERVOIR HAS CONCRETE WALL AND FLOORS AND TIMBER ROOF

The concrete throughout is a 1:2:4 mixture to which was added 5% of hydrated lime. The inside face of the wall has a ½-in. coat of 2% Medusa cement for waterproofing.

Water was turned into the reservoir July 18, and no leaks have appeared. The completed structure cost $13,760. W. S. Dole, deputy water commissioner, designed the reservoir and it was constructed by city labor.

Cantilever Concrete Trestle Bents Carry Steel Spans

Three Tracks and Gantry Crane Are Carried on the Trestle with Suspended Steel Bins for Ore and Coal

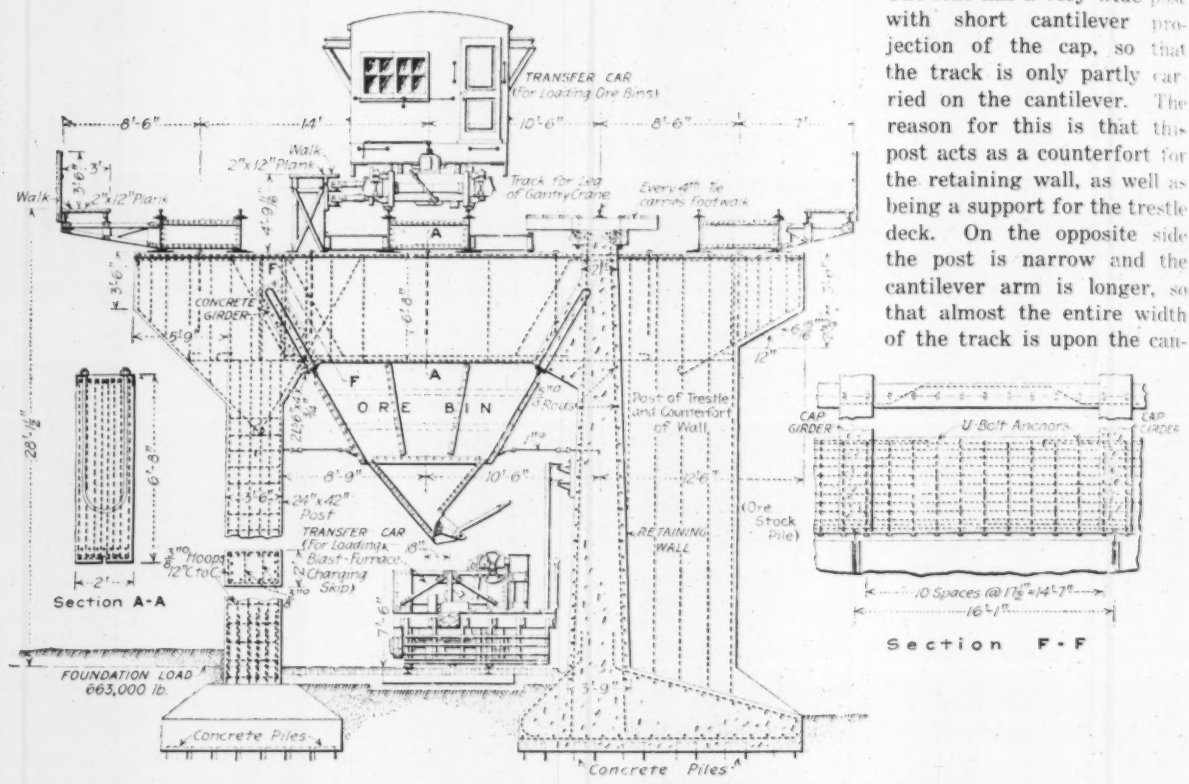
HEAVY loads and special conditions of loading are involved in a three-track trestle of novel design at the new Haselton No. 5 blast-furnace plant of the Republic Iron and Steel Co., Youngstown, Ohio. The bents, which are spaced 16 ft. c. to c., are of reinforced concrete, each having two posts and a heavy cross girder or cap with cantilever extensions beyond the posts. Extending between the bents and built integrally with them is a reinforced-concrete wall which carries a rail for one leg of a traveling gantry crane and acts as a retaining-wall for the ore stock-pile. The bridge of the crane spans the trestle. It carries a trolley with grab bucket, serving the tracks, bins and stock-pile.

Beneath the caps are steel bins for ore, coke and coal. The bins have bottom gates for loading electrically operated charging cars which run on a surface track betwen the trestle posts. This track space is paved with brick. Ore may be dumped into the bins from cars on the middle track. It may also be handled from cars on the outer tracks or from the stock-pile of the grab bucket of the gantry crane. From the bins it is delivered to the charging cars, and these in turn dump into a hopper which feeds the skips on the charging incline of the blast furnace.

The bins are suspended from the trestle by inclined U-bolt hangers, which are in the planes of the sides of

CONCRETE TRESTLE WITH CANTILEVER CAPS CARRIES TRACKS, GANTRY CRANE AND ORE BINS

the bins. The sides are stayed by horizontal rods anchored into the trestle post and the retaining wall. The hangers on the outside are embedded in the concrete stringer between the bents, the stringer being inclined so as to form a continuation of the sloping side of the steel bin. The hangers on the ore bin side are embedded in a stringer formed as part of the wall which carries the crane rail. In the former case the load is carried directly by the stringers. In the latter case it introduces an overturning stress in the tall and relatively thin wall. This is provided against by a very wide toe on the outer side of the wall.



CROSS-SECTION OF REINFORCED-CONCRETE TRESTLE WITH ORE BINS SUSPENDED BENEATH DECK

The capacity of the bin for one bay, 16 ft. long, between centers of bents, is 2636 cu.ft. if filled to the bottom of the track stringers, or 3122 cu.ft. if the load is heaped up to the top of the stringers. With ore at 150 lb. per cu.ft. the weight of load will be 177 or 209 tons respectively.

The track stringers are 30-in. I-beams, resting only on base plates on the caps, and those of each track are connected by cross frames. The 85-lb. rails are laid upon the top flanges of the I-beams and secured by bolted rail clips. These separate single-track spans are designed for 100-ton locomotives, and the trestle bents are designed to carry such locomotives running simultaneously on the three tracks. The two outer tracks are mainly for railway cars, from which material is unloaded by the gantry crane, the grab bucket delivering the material required either to the trestle bins or the stock-pile.

The middle track is for bottom-dump cars or an electrically operated transfer car. This latter is loaded by the gantry with ore from the stock-pile and discharges it into the bins.

The load on the single rail carrying the leg of the gantry crane is 68,000 lb. for each of the four wheels. The outer track stringers have cantilever brackets carrying footwalks. Walks are provided also along the ties of the single-rail crane track and on the steel structure which carries the third-rail conductors for the middle track.

The bents are not symmetrical about the center line. One side has a very wide post with short cantilever projection of the cap, so that the track is only partly carried on the cantilever. The reason for this is that this post acts as a counterfort for the retaining wall, as well as being a support for the trestle deck. On the opposite side the post is narrow and the cantilever arm is longer, so that almost the entire width of the track is upon the cantilever. This construction was used in order to keep the bending in the cross girder or cap at a minimum and also to provide a support for the inclined concrete girders which support the steel bins.

The narrower posts have rectangular footings, while the footings of the wider posts are connected by the broad toe of the retaining wall. The foundations in both cases are Raymond concrete piles, cast in place. Under the broad continuous footings they are spaced 36 in. on centers transversely and 39 in. longitudinally. Under the rectangular footings they are spaced 18 in. on centers transversely and 33 in. longitudinally. The soil is mainly a sand and gravel fill.

The trestle is about 612 ft. long. Beginning at one end, ten bays are utilized for carrying ore bins, as described. Then come five bays for coke bins, and the bents for these have no steel reinforcement. These are followed by three bays for ore bins, two for coal bins and one for a scrap bin. The concrete is a 1:3:5 mix, and all reinforcement is of square twisted bars.

This structure was designed and built by Arthur G. McKee & Co., contracting engineers, Cleveland, Ohio.

Engineering Graduates and Industrial Demands

By L. W. W. Morrow
Associate Professor and Acting Director, Department of Electrical Engineering, University of Oklahoma

Remarkably clear is this treatment of the relation of engineering education to the demands of industry, which appeared in the October "Bulletin" of the Society for the Promotion of Engineering Education, and is, by permission, reprinted in its original form. While "Engineering News-Record" realizes that the article is primarily addressed to the faculties of technical schools, Prof. Morrow's presentation of the historical eras of modern engineering, the causes underlying the transitions which have occurred and are occurring, and his explanation of the difficulties that must be overcome in reducing the time-lag between curriculums and the type of engineer graduates demanded by industry, are full and illuminating. He points out that there is no uniformity in course content or manner of treatment in the numerous schools, intimating that a closer understanding among them might be of value to everyone. The article closes with a plea that the industrial world be made aware of educational conditions and of what they should expect of four-year graduates.

THE current technical press has contained several articles regarding the capabilities of engineering graduates in the industrial world. At the meetings of the various technical societies there have been frequent criticisms of present educational methods and engineering curriculums.

It is alleged that the present curriculums are unsuited for modern industrial conditions; that educators are too academic and are not in touch with the progress of industry and the problems encountered in the commercial field; that educational methods are antique and inefficient; that the content of the curriculums is out of date and unbalanced.

Charges are made that engineering graduates are lacking in thorough training and knowledge; that they use bad English; that their knowledge of fundamentals is very hazy; that their training makes them more suited for designers than anything else; that graduates have no knowledge of commercial methods, apparatus or economics; that as a whole the graduates have a hazy idea of several things but accurate knowledge of none.

It is stated that engineering graduates are from one pattern; that initiative and personality are repressed rather than cultivated; that they have become inaccurate and lazy through improper training.

Other criticisms are made but, in general, the foregoing statements express the sentiments of those advocating reform in curriculums and educational methods. The men who make the criticisms are industrial engineers; men who judge engineering schools by their product and its fitness for their requirements; men who demand efficient employees; men whose viewpoint is necessarily that due to their environment.

These men are unaware of the fact that engineering educators have been working to improve curriculums and educational methods for the past ten years through the Society for the Promotion of Engineering Education; they do not know of the great strides made in the field of engineering education. Their criticisms are strictly selfish and are made solely from a commercial viewpoint.

On the other hand there are enough criticisms to cause engineering educators to pause and consider them. The criticisms may be just in some respects; there may have been too great a tendency to remodel and change engineering educational methods and curriculums from a purely academic point of view. From an analysis of the criticisms it may be possible to consider more specifically industrial demands. At all events the criticisms should be considered with a view to eliminating them through educational campaigns or through educational changes.

A consideration of the points alleged leads inevitably to a historical sketch of the growth of engineering and changes in industrial conditions; the growth of the engineering school and finally the changes in the relations between the schools and the industrial world.

> *The character of engineering training has always changed with the demands of industry. The designer gave way to the operator who, in turn, is being supplanted by the specialist and executive.*

Historically, engineering may be divided into three eras, each era being determined by the chief industrial demand. These eras are as follows in point of time: the era of the designer and inventor; the era of the operator and constructor and finally the era of the specialist and executive.

The demand for inventors and designers was greatest at the beginning of the so-called industrial age. The invention of the cotton gin, power loom, steam engine, machine tools; the discovery of new forces for use in transportation and communication and for the transformation of energy; the development of the factory and concentrated manufacture as against the individual producer, all these things created a great demand for inventors and designers—men who were qualified by fundamental knowledge of science to design and produce new machines, to discover new applications for available forces and to investigate existing forces with a view to developing machines for commercial applications.

The years from 1890 to 1900 saw the multifarious applications of the forces, materials and ideas developed during the previous era. The railway, the telephone, the power plant, the steam engine, the electric motor and generator, the turbine and water wheel, the machines for the manufacture of diversified products—all these were developed and applied with great rapidity.

The great development in commercial applications of engineering machines created a demand for skilled operators and constructors. Men were desired who were capable of constructing machines from design drawings; men were wanted in the drafting rooms to make the drawings; men were wanted to operate the engines, machines and power plants used for commercial purposes. The combined demands for the above types of men were so great that the industries were forced to train men through the adoption of the apprenticeship system.

Economic reasons have forced the several changes in the engineer-type. The concentration of power development, of manufacture, of sales, and of financial resources, is responsible for the present type.

The years from 1900 to the present time were noted for the concentration of power production; of manufacture; of sales organizations; of financial resources. The industrial world was organized and concentrated for economical reasons. The engineering fields were divided and subdivided for reasons of efficiency. It was an era of efficiency and economy in design, operation and production. The industrial world desired executives, highly trained specialists in engineering, organizers, business managers and financiers in connection with its engineering and industrial problems and conditions.

The foregoing historical divisions of the industrial age are not strictly accurate, as each division is not a discontinuous function of time. There is a demand for all types of men at the present time; as the limits in industrial developments have never been ascertained, however, the most insistent demand is as outlined and the supply is least. The demand for designers, operators and constructors has been greatly lessened by the increased supply of such men developed by the industries and the technical schools. The gage of the peak demand for men is found in the salaries. At this time few designers, operators or constructors receive $10,000 per year, yet many executives, specialist engineers, sales engineers, consulting engineers and efficiency engineers receive that figure. Fifty thousand dollars would be a better comparative figure as regards the number of men receiving such salaries in the two classes.

The engineering school is a product of the industrial age and is a result of industrial demands. It was born in the inventive era and was a direct result of the desire for men who had fundamental training in science sufficient for them intelligently to use the newly discovered machines, forces, materials and processes. The engineering school grew gradually from a school of pure science to one of applied science because of the insistent demand of industries. The growth and evolution of curriculums were slow processes and lagged far behind industrial demands as regards time.

The era of application and operation gave an impetus to engineering schools that has existed almost to this time. The demands for skilled operators, draftsmen and mechanics were so great that industrial organizations were forced to supply some of the men through apprenticeship systems. The engineering schools were insufficient in number to fill the demand for their products. New engineering schools were founded in great numbers. The field of pure and applied science was sharply divided and defined in this era. The engineering curriculums were changed in order to train students in the use of industrial apparatus in wood and machine shops and in testing laboratories for steam and electric machines. The schools devoted a great amount of time to design and drafting and also taught the fundamentals of engineering as contained in the pure sciences. This was the golden age for engineering schools—their products were in great demand and excited no criticism; the engineering profession was very popular and caused the schools to receive private and state support as well as a great increase in the number of students.

The sudden popularity of engineering created during the period previous to 1900 filled the schools, and produced a surplus of designers and operators when these were no longer the prime need of industry.

The era from 1900 to date, with the resulting changes in industrial conditions and demands, has greatly changed the working conditions for engineering schools and caused some dissatisfaction with their products. The popularity of engineering as a profession created in the previous era caused a large increase in enrollments for several years and in the number of engineering schools. These conditions existed long after the initial industrial impetus had ceased. The schools still kept in view the training of designers and operators although the demand for such men was decreasing yearly. Engineering schools continued to add large and expensive shops and laboratories to their equipment; some even attempted to manufacture commercial products in order to train students in commercial methods. The apex of this condition as regards the engineering schools was reached long after industrial demands had changed. The time-lag between school curriculums and industrial conditions is very great and can only be shortened by more intense coöperation between the schools and the industries through faculty associations with industrial pursuits.

The engineering schools awoke to existing conditions in industrial pursuits only a few years ago—the prime source of awakening being a decrease in engineering enrollment. This was explained in part by the growth in popularity of agriculture at this period, but this alone could not be sufficient reason for the decrease in the popularity of engineering as a profession. Upon investigation, the schools found that the industrial conditions and demands had changed. Industry now desired specialist engineers—a man who was not only an electrical engineer but also a specialist in one branch of electrical engineering such as railways, telephony, illumination, transmission, etc. The engineering problems were largely problems in economics and no longer those of design or operation. The industrial world also desired executives and business managers and could not obtain a sufficient number. Industry was looking to the engineering schools for their supply and found it unfitted for the existing conditions.

The schools found it advisable to conform to industrial demands, as their salvation and life depended upon their products obtaining larger salaries than were being given them. In a haphazard way and at different times the schools began to change their curriculums to con-

form to the new conditions. In this revision of curriculums, instead of omitting previous courses and replacing them by others of the desired type, they simply added to the existing curriculums specialized courses in engineering, economics, business law and business management and made no attempt to increase the time alloted for an engineering degree. Civil engineering students, for instance, were not only given the previous content of the curriculum but were also given specialized courses in concrete construction, hydraulic engineering, structural engineering, railroad and highway engineering, economics, English, business management and business law. The same conditions held true in electrical and mechanical engineering.

During the elapsed time the knowledge of fundamental laws and their applications had increased, and so required more time for their assimilation with the same degree of thoroughness.

The schools were forced to attempt the impossible in order to maintain their reputation as the most valuable source of men trained for industry. The four-year course proves inadequate.

What was the result? The schools found that they had attempted the impossible; they found that it was impossible to have such curriculums in a four-year course. They found their graduates were not thoroughly trained even in fundamentals; that their reputations were on the wane; that their enrollments were decreasing as a consequence; that criticisms were severe; that radical steps must be taken to avert disaster. The realization of this condition was a slow process and was marked by no organized effort, on the part of the schools, to revise their educational methods and curriculums. Even now a great many schools do not realize that such conditions exist and have taken no steps to analyze the trend of engineering education. The situation is aggravated by the demands of industries for the type of men that cannot be furnished by engineering schools in a four-year course; the industries do not realize the conditions engineering educators face or the problem they have to solve—industry demands results irrespective of conditions. The schools have proven through costly experimentation that the type of men demanded is an impossibility, yet some schools are still trying to supply the demand.

The industrial engineers desire men trained in fundamentals, operation, design and construction and specialized engineers along one line; they desire men trained in economics, business organizations and executive duties. They criticize the schools because they do not furnish such men in a four-year course.

The schools should admit without question that they fail to supply the demand; that they cannot do so under present conditions in a four-year course. It is impossible to train a high-school graduate in four years so that he will possess all the qualifications demanded by industries. The schools should admit these facts and submit their brief to industrial engineers.

Engineering schools are facing a crisis. Industry demands results that are not forthcoming. The lives of engineering schools depend upon their supplying the demands of industry. The problem must be solved and will only be solved by the efforts of engineering educators, for they are the ones vitally interested. An educational campaign is the first step in the solution of the problem. Industry and industrial engineers must be made to realize that they are demanding the impossible, that engineering schools have attempted to supply such men and found it impossible, with the result that the schools have been criticized because their products are inaccurate, hazy and ill-trained in many respects.

What is the solution of the problem? How can industrial demands be satisfied?

Longer courses and summer and coöperative courses became inevitable. Strong graduate faculties and other radical changes partially meet the situation, but a new attitude toward the question is likewise demanded.

A six-year course has been offered as a panacea. The objection to the six-year course is the time required. Industries have offered no inducements to cause men to take six-year courses. Curriculums for six-year courses are very immature at the present time. Such a course requires a strong graduate faculty, as the time has not arrived for abolishing the four-year course. The criticism that curriculums are faulty, that all students are given the same training; that initiative is not developed; that there are no facilities for training in commercial operation, methods, processes, and executive duties—all these conditions cannot be changed by simply spreading out the present curriculums over two more years.

Six years is required to give accurate and thorough training in the fundamentals of engineering and some specialized training in a main division of engineering such as civil, electrical or mechanical. The engineering schools are equipped to give such training as to faculty and apparatus. It is feasible to balance curriculum content and to allow for the natural aptitude and personality of students. From the above considerations it would seem that the addition of two years would not help to supply the commercial demand except by removing the criticism as to inaccuracy in fundamentals. It would merely give the student a proper foundation.

Commercial methods in manufacture, operation and construction can only be obtained through academic and commercial coöperation. It is impossible for the schools to have up-to-date equipment on a commercial scale. This criticism could be readily removed, however, through coöperative effort. Students could be required to work in the industrial world at least two summers before a degree is granted. The type of work, pay, etc., could readily be worked out in specific cases. This field offers a splendid opportunity for development.

Fundamental training in engineering is the best foundation for executives and organizers. It is not possible to give more than this foundation in a four-year course, so the only way this demand can be filled is through the graduate school. There is no place for such special training in the four-year course and students will not take graduate work unless there is some inducement for such work. This condition holds true for specialists in one line of engineering. The schools should remove all specialization from their four-year courses. They should develop strong graduate schools, they should obtain the coöperation of industries and offer inducements to proper men to pursue the graduate courses.

Some of the faults at present found with technical graduates are traceable to this being a period of transition, but manufacturers should realize the national limitations of what may be accomplished in school.

Taking up the chief criticisms, it is found that in many cases engineering graduates of recent years have lacked thorough and accurate training in engineering. This was due to faults in the curriculums and methods of teaching and also due to the attempt of industrial engineers to get the impossible. This condition and the above criticisms can be removed through removal of specialization, balancing the fundamental curriculum content and educating the industrial engineers.

The supply of specialists and executives demanded by industrial engineers can only be obtained through strong graduate schools. The graduate schools can only be developed through coöperative effort.

The knowledge of commercial apparatus and methods demanded by industry can be obtained through required commercial summer work, provided industries coöperate with the schools to offer some inducement for such work.

The schools should bear in mind the fact that their function is to furnish industrial engineers and should not be too academic in their aims and curriculums. The present curriculums of engineering schools show a startling difference in content. There is no uniformity in curriculum content, time allotted the different courses or methods of presentation. It seems feasible to have a better agreement among engineering schools as to the above points.

The industrial world should be made aware of educational conditions through an educational propaganda; should be taught what to expect of four-year engineering graduates; should be strongly urged to coöperate with the schools as to summer work and, finally, should offer inducements to students to pursue graduate work so as to cause the development of strong graduate schools.

Some of the criticisms are well founded and can only be removed by conscientious effort of engineering educators, other criticisms are not logical and are made through ignorance of the conditions and results possible in engineering education.

Synchronous Motors Drive Camden Pumps

A recent example of electric pumping which is mutually advantageous to water-works and an electric-supply company is found at the Del Air Station in Camden, N. J. Here two 12-in. 5,000,000-gal. single-stage centrifugal pumps are each driven by a 200-hp. Westinghouse synchronous motor. Power is received at 2200 volts direct from the lines of the Public Service Electric Co. During a test run, these two pumps operated against suction heads of 27.33 and 26.5 ft., and a pressure head of 150 ft. The over-all efficiency was about 72%. In addition to the main units, there are two rotary vacuum pumps, each driven by a 10-hp. induction motor. The desirability of such an installation to the power company lies in the long hours of use and corresponding high load factor, and the possibility of high-power factor by over-exciting the motor fields.

Mechanical Loading at Concreting Plant Eliminates Laborers

Estimate Indicates That Crew of 25 Men Can Do Work Ordinarily Requiring Force of 42 Bins Mounted on Truck

SPECIAL equipment of a traveling concreting plant has been planned in order to eliminate the usual gang of wheelers and shovelers for loading the charging skip of the mixer, and thus reduce the present difficulties of labor shortage. Greater capacity of output is also claimed for this plant. It is designed particularly for concrete road and paving work, or for placing the concrete base for other paving.

At the head of the plant is a steam roller or tractor hauling a light derrick car having a 20-ft. boom and ½-yd. grab bucket. The roller supplies steam for the derrick hoist. Next to it is a self-propelling bin car for 3 yd. of sand and 3 yd. of stone. Behind the bin car is a self-propelling mixer, preferably of 1 yd. capacity. Stone and sand are piled on opposite sides of the roadbed, leaving a passage for the roller and derrick car. The grab-bucket loads the materials into the bins, which discharge through spouts directly into the charging skip or scoop of the mixer. This skip must be of the box type, and is marked with gage lines showing the proper depth of charge for the coarse and fine aggregates.

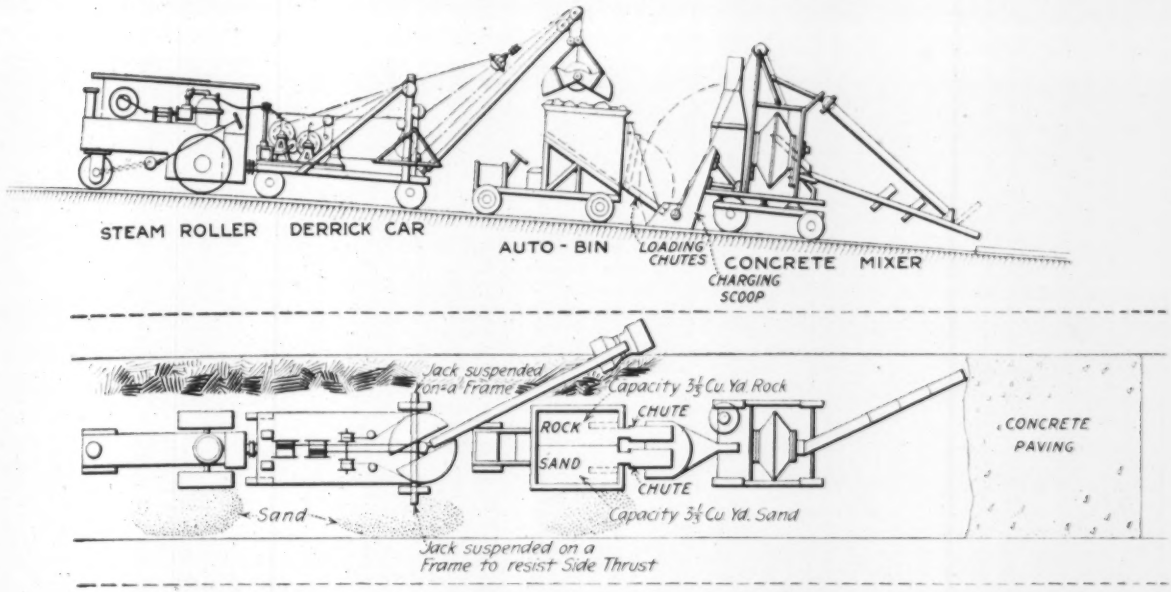
A locomotive crane on traction wheels may take the place of the roller and derrick car, but the roller is a part of the contractor's plant and both roller and derrick are operated by one man. The outfit as first described, is likely, therefore, to entail less expense for new equipment. Ordinarily a three-drum hoist would be required for the derrick, but by means of a special device a two-drum hoist can do the work. The bin car is made a separate unit in order that it may be kept in position to feed the scoop of the mixer.

This concreting outfit and method of working have been devised by O. N. Gardner, Jamestown, N. Y. He estimates that a crew of only 25 men will be required, as compared with 42 men where the ordinary method of working is employed. Furthermore, he asserts that the charging of the mixer can be done in 90 sec., as compared with 110 sec. by hand work, so that the output capacity will be increased materially. The accompanying table shows the force for the ordinary wheelbarrow system and the new grab-bucket system.

For the force and wages given, with 30c. per hour for common labor, the daily cost for labor would be $85.50 per day for the mechanical system and $131.50 for the

FORCE FOR CONCRETING PLANT WITH HAND AND POWER CHARGING OF THE MIXER

	Daily Wages	Wheelbarrow System	Grab-Bucket System
Wheelers for stone	$3.00	15	
Wheelers for sand	3.00	7	
Concrete graders	3.00	4	4
Forman	3.00	4	4
Subgraders	3.00	3	3
Cement handlers	3.00	4	4
Finisher	5.00	1	1
Mixer operator	5.00	1	1
Auto-bin operator	5.00		1
Roller and derrick operator	5.00		1
Clean-up for grab bucket	3.00		2
Foreman	4.00	1	2
Foreman	5.00	1	1
Water boy	1.50	1	1
Total men		42	25



ROAD OR STREET CONCRETING PLANT DISPENSES WITH WHEELBARROW AND SHOVEL GANG

hand system, or a saving of $46 per day. The figures are based on a mixer with drum holding 1 cu.yd. of unmixed material and a 4-bag batch of 1:1½:3 concrete. The volume of loose material in the charging skip would be four cu.ft. of cement, six of sand and 12 of stone, or 22 cu.ft. The batch of mixed concrete would have a volume of about 14.66 cu.ft. With 40 batches per hour the concrete placed would be 217½ cu.yd. per 10-hr. day. But with the slower charging of the mixer by the hand system there would be only about 320 batches and a smaller output.

No road or street work has yet been carried on with such an outfit. Direct loading of the material bins by a grab bucket has been employed in the construction of retaining walls by Mahoney & Swanson, contractors for grade separation work on the Erie R.R. at Jamestown, N. Y. The bins and mixer are mounted on a car, and in the first place the materials were shoveled from cars to a bucket elevator serving the bins. At the suggestion of Mr. Gardner a locomotive crane with grab-bucket was installed, loading the materials directly from cars into the bins. He states that this effected a saving of $20 per day in labor and increased the output capacity of the plant.

Standard Symbols for Mechanics and Hydraulics

Committee of the Society for the Promotion of Engineering Education Hopes to Unify Present Practice

LETTERS sent to professors of mechanics and hydraulics who are members of the Society for the Promotion of Engineering Education, and to certain other persons, were the starting point of the efforts made by the committee on technical nomenclature of the society to standardize symbols which are used in mechanics and hydraulics. These letters requested that the recipient suggest such symbols as he thought should be used as standard in these two divisions of knowledge. The replies were considered, together with the suggestions made in an article in *Engineering News-Record*, of Apr. 12, page 102, by R. Fleming, of the American Bridge Co. Of the 18 replies received, only 13 were accompanied by a list of symbols, and of the five remaining only one proposed standardization of symbols by the committee.

It is very interesting to note that of the 65 concepts considered by the 13 men turning in definite suggestions, agreement was had on only one; that for rectangular moment of inertia. The use of I, in this instance, is of course universally understood, but it is not so easy to see why two of the replies should oppose the use of g for the acceleration due to gravity or E for Young's modulus of elasticity.

The list as received and organized was sent to about 50 men—professors, editors, and engineers—accompanied by a letter explanatory of the method followed in making the list, and requesting that criticisms be freely made. To this request there were 19 replies, of

LIST OF SYMBOLS APPROVED BY COMMITTEE

A	Area	m	Mass
a	Linear acceleration	N	Revolutions per unit of time
B		n	
b	Breadth	O	Center of rotation
C	Constant	P	Concentrated load
c	Distance of extram fibre from neutrl axis	p	
D	Diameter	Q	Quantity of liquid flowing in pounds
d	Depth	q	
E	Young's modulus of elasticity	R	Reaction
		Rh	Hydraulic radius
e	Eccentricity of application load	r	Radius
		St, Sc, Ss	Unit stress in tension, compression, shear
eh, em, ev	Efficiency (hydraulic, mechanical, volumetric)	s	Distance passed over
F	Force	T	Torque
f	Coefficient of friction	t	Time
G		U	
g	Acceleration due to gravity	u	
H	Head	V	Volume
Hp	Horsepower	v	Linear velocity
h	Height	W	Weight of a body or total weight
I	Rectangular moment of inertia	w	Angular velocity
J	Polar moment of inertia	X	
K	Coefficient, constant	x	
k	Radius of gyration	Y	
L	Length	y	Deflection of beam
M	Moment of force or sum of moments of forces	Z	Modulus of section
		z	

which number three were sent by editors of technical journals, five by engineers, and the rest by professors in various universities. The committee also received suggestions from representatives of some of the national engineering societies and from a number of prominent publishers of engineering books. It is felt, therefore, that while the list is not large, it is fairly representative.

Practising engineers approved heartily of the idea of a standard list, as did the editors, who objected to the use of Greek letters with the exception of π. Neither of these classes expressed a preference as to the particular symbols that might be selected, provided they received universal acceptance. On the other hand, professors went into considerable detail and showed strong preferences, but differed widely in their views.

The majority of the replies approved of a standard list based on the one submitted, and, acting on this, the accompanying list was drawn up and will be submitted by the committee as a "suggested" standard to the next annual meeting of the Society for the Promotion of Engineering Education. There is hope, however, on the part of the committee that publication and consequent criticism may result in a better and more widely acceptable list of standard symbols for mechanics and hydraulics which the committee may feel more willing to indorse as "approved."

The members of the committee on technical nomenclature of the society are John T. Faig, chairman; S. C. Earle, W. D. Ennis, F. N. Raymond and Charles Warren Hunt.

Cement Model Gives Grades at Complex Street Intersection

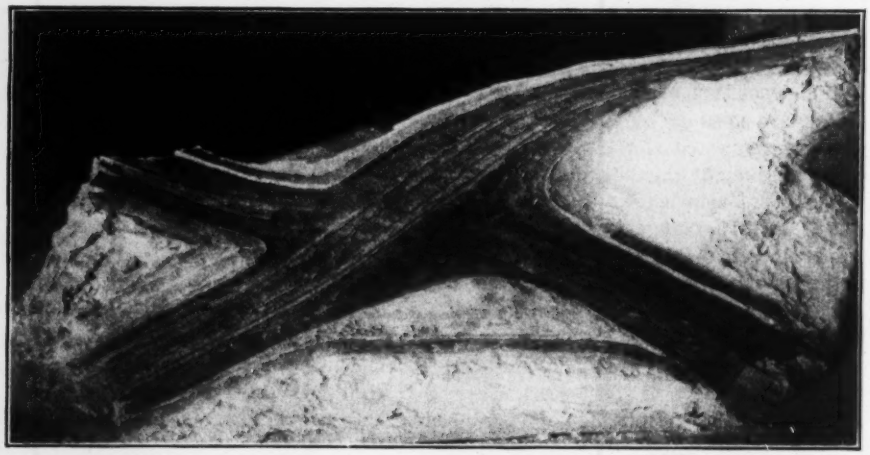
HOW to find the smoothest riding surface for street intersections where all four come together at different grades, is a problem which presents itself frequently in San Francisco, a city "built upon seven hills." A solution has been found in the use of models made of cement mortar and surfaced with neat cement.

The illustration shows a model made for an intersection where two of the streets are on very heavy grades and, because no two angles of intersection were alike, the four curves all had to be different. In such cases the models are most effective. The scale in this case was 1 in. to 3 ft. for the vertical and 1 in. to 10 ft. for the horizontal.

The model is carefully made to scale and the grades are established, to the point where the intersection surfaces begin, in the following manner. Pieces of cardboard cut to scale, and to the preliminary grade for curb and rail, are set in their proper places and fastened to a baseboard. The intervening spaces are then filled with a stiff cement mortar and rough shaped to grade with a trowel and putty knife. The surface is smoothed out after the addition of about ½ in. of neat cement to the mortar surface. In working up these surfaces consideration is given to the route carrying the heaviest automobile traffic, allowing it the more favorable curves if preference is to be shown.

After the model has been finished acceptably, the material is allowed to harden and from measurements, carefully made with a steel scale, a set of notes is prepared, showing the location and grades of the four curbs and giving elevations on each vertical curve along the center line, (1) at the beginning of the curve, (2) at its midpoint and (3) at the end. In addition to this, the grades of center lines are shown in the notes at several convenient points along the tangents.

The plan has been developed and applied to construction work by James M. Ownes, assistant engineer in charge of highway design, under M. M. O'Shaughnessy, city engineer of San Francisco.

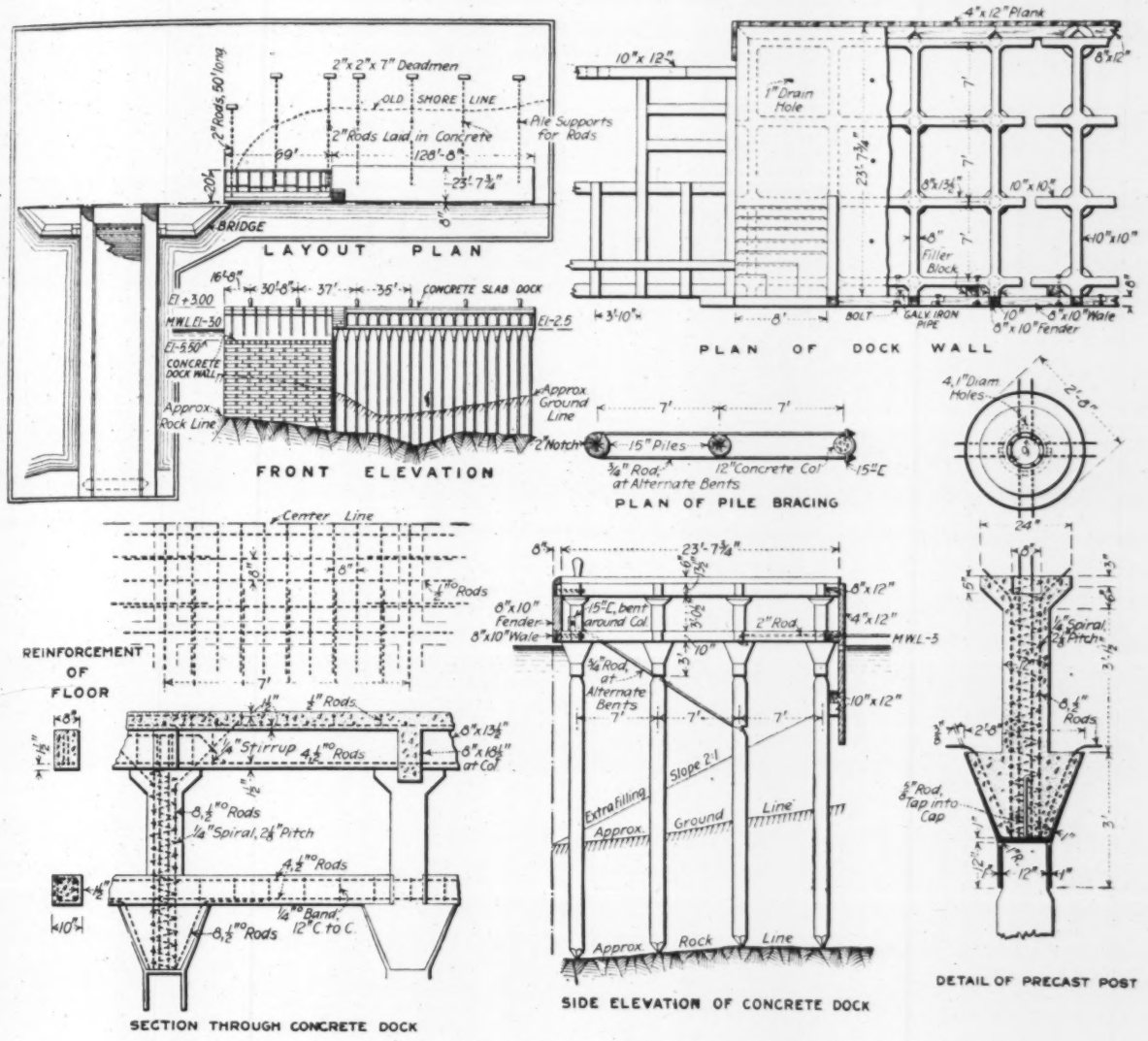


ACCURATE MEASUREMENTS TAKEN FROM COMPLETED MODEL ESTABLISH SATISFACTORY GRADES

Wharf Has Combination Timber and Concrete Piles

Precast Concrete Columns Fitted to Caps on Wooden Piles Which Form Foundation Frame for Concrete Quay Wall

THE City of Buffalo has now under construction on Bird Island, which lies between the Black Rock Channel and the Niagara River, a short length of quay wall of remarkable design. The wall or wharf is being built in about 20 ft. of water at what will be the bulkhead line but which is now about 50 ft. outstream from the shore line. A fill is eventually to be placed behind the wall so as to make it a marginal quay bordering on the Black Rock Channel, as shown in the layout plan herewith. A stretch of 69 ft. of the wall immediately alongside of a bridge is of the typical Great Lakes construction; that is, a timber crib filled with rock, carrying a concrete block face wall. Extending therefrom a distance of 128 ft. 8 in. is the quay wall, the subject of this article. This wall is a reinforced-concrete beam-and-girder superstructure, resting on columns which are combination timber and concrete. The details



STRETCH OF CRIB DOCK AND COMBINATION TIMBER AND CONCRETE FRAME DOCK AT BUFFALO, N. Y. NEW WHARF AT BUFFALO HAS PRECAST CONCRETE COLUMNS FITTING INTO TIMBER PILES FOR BASE SUPPORTS

of this structure are shown in drawing herewith.

The footing piles are of wood 14 to 16 in. in top diameter. The top is trimmed down to fit a special cast-iron cap which carries the precast column, into which the framework of the wharf fits. This column has an enlarged conical base fitting into the bell of the casting, and from this outstanding base the main column shaft rises leaving an annular ring on which are carried the concrete stringer beams which form the lower frame of the wharf. The main column shaft is belled out at the top and grooved there to carry on a center line the transverse and longitudinal reinforced-concrete beams of the upper part of the wharf. The pile footings are tied together by ¾-in. rods notched into the third pile from the outside and rising to the outer row.

In construction the precast and fitted wood and concrete column-piles are to be set one by one by a derrick boat in their proper location and lowered through the very soft bottom to rock. The proper cut-off length will then be noted, the pile pulled out and sawed off on the bottom to bring it to the proper elevation. A row of these piles will then be placed, the fill being put in beforehand in cases where there is not enough cover over the rock to insure stability. When a bent of these piles is in place and properly braced, the reinforced-concrete framework above will then be deposited in forms in place.

As shown in the cross-section, the quay wall is nearly 24 ft. wide, will be protected on the outside with a fender system, and has on the inside a line of continuous timber sheathing to lower the slope of the tailing fill. When in position the wall is tied back to deadmen in the solid ground with rocks fitted with turnbuckles and set into the next to the inside row of column piles.

This work was designed in the office of the city engineer of Buffalo, Capt. G. H. Norton, and the work is being done by the Great Lakes Dock and Dredging Co., W. P. Feeley, district engineer.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Twin Cities Have Extremes in Societies

Observers of engineering society activity have often had occasion to remark the striking difference in society interest in the neighboring cities, St. Paul and Minneapolis. An illuminating statement is made by a prominent local engineer in reply to questions as to the reasons for this difference. He confirms the belief that much less working coöperation is secured in Minneapolis than in its sister city, and explains the situation partly by local conditions and partly by organization factors. The following summarizes his statement:

Minneapolis was settled by men of old New England stock who have controlled the financial situation and in a large measure the government of the city, notwithstanding the present Swedish population. St. Paul is a cosmopolitan city, with French, German, and Irish predominating; when two of these elements conflict, it is a draw unless the third can be induced to take sides.

Minneapolis Has a Close Organization

The Minneapolis Engineers' Club has a limited membership. This limit was 75 until a short time ago, when it was raised to 125. There are probably 250 more eligible to membership. The society is governed by a board of directors virtually self-perpetuating. There is not much interest in the society, because if a member starts anything the board of directors can kill it. Virtually no activities are started, except those initiated by the board of directors. The majority of the board of directors has always belonged to the conservative element, the higher social class of the city, and as one of them, of good old New England stock, expresses it, they have "preferred quality to quantity." The directors rather look upon all talk of engineering coöperation as being somewhat plebian in principle. When the club has a meeting, it is usually in connection with a dinner, somewhat formal in character and held at one of the promient clubs. There is probably more dignity in the club's doing than the ordinary member of an engineers' club likes.

Democratic Principles Govern the St. Paul Society

There is no limit to membership in the St. Paul Engineers' Society. All classes of engineers and those surveyors who have good reputations are members. There is no board of directors. The officers constitute the governing body, and they carry out the wishes of the majority of the members as expressed in open meeting. In every respect the society is a democratic organization. There is now a committee working to revise the constitution, to make it even more democratic and to enlarge the scope of activity of the society. The condition of membership is honorable service in the fields of engineering and allied sciences. The object of the organization is to make the profession of ever-increasing service to society.

A progressive spirit directs the work of the St. Paul Society. When any member suggests action likely to promote the good of the society, it is certain to get the prompt support of all. The members are alert in keeping track of what is going on locally and advising the officers or the chairmen of committees.

Of course, this harmonious condition is occasionally troubled by objections arising from timidity or conservatism. Some members urge greater caution, and express a fear that the society may become radical. Up to the present, however, nothing undignified has been done, nor is it likely to be.

What Happened to the Joint Engineering Board

The remarkable Minnesota Joint Enginering Board movement, started some years ago to bring the engineers of the Twin Cities—and of the whole state, for that matter—into closer touch, was checked in its progress early last season, after making a good start. Last year the Board carefully analyzed every bill presented to the legislature that in any way could affect the engineers, and it went on record concerning their merits, favoring or opposing this or that bill or certain of its features. Later the Board lost several prominent members: Mr. Darling, representative of the American Society of Civil Engineers, went to Russia, Mr. Street, of the American Institute of Electrical Engineers, left the country, and George Rathjens, secretary, was made a major and went to war. As a result it has been dormant during the summer. Now, however, there is promise of renewed activity. The Board was reorganized Nov. 3 and is at present outlining a campaign of work.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

The Engineer in Politics

Sir—The letter by C. E. Drayer in your issue of Nov. 1, entitled "The Engineer in Politics" was read with a great deal of interest.

Recently the writer had occasion to meet the president of one of the leading banks of Cleveland. During a conversation on various subjects this man said that he considered the profession of civil engineering the highest one in which a man could engage, and expressed regret that the engineer did not seem to realize his social and political status and take the place in the community to which his profession entitled him. The banker was asked what he considered it necessary for the engineer to do in order to gain this enviable position. He replied that it was simply a matter of coöperation.

I mention this case merely as an illustration of the fact that the public is more than ready to recognize the engineer, but the regrettable fact is that most engineers are not willing to be recognized as leaders in the body politic; not that they do not feel capable of living up to the standards required for the maintenance of a prominent position socially and politically, but because.

apparently, the engineer is naturally unobtrusive and unassuming.

I think it safe to say that every engineer realizes the importance, or rather the necessity, of coördinated and concentrated effort where large things are to be accomplished, and I think it likewise true that every engineer secretly wishes the profession to take its proper place in the community—and yet the most obvious means of accomplishing this end, coöperation, is continually disregarded.

Engineering News-Record has consistently preached this doctrine for a number of years, and it is beyond dispute that the majority of engineers in this country realize the importance of coöperative effort if the dream of leadership in public affairs is to be realized. Therefore, why not coöperate? B. H. SIMPSON.

Cleveland.

Specifications for Topographical Surveys of Drainage Districts

Sir—There has been considerable comment in your columns recently regarding topographical surveys and the cost of same. I am attaching herewith specifications covering survey work for drainage districts in Kansas. The law requires that every drainage district organized shall cause a topographical survey to be made by some competent engineer, showing the physical characteristics and location of any right-of-way, roadbed, bridge or other property or improvements under the control of any railroad company; also the location of all highways, public utility property, state and municipal improvements, ditches, farms, lakes and bayous.

The attached specifications were made up with the idea that the survey should fulfill the requirements of the law. In regard to costs of such surveys, there have been a number of contracts let at prices ranging from 14 to 21c. per acre. The topography of the districts surveyed is generally rolling and some have considerable timber, though very little dense undergrowth.

I would be glad to have suggestions in regard to the specifications from other engineers.

J. B. MARCELLUS,
Engineer in Charge.

Manhattan, Kan.

[The specifications follow.—Editor.]

Contract and Specifications for Topographical Survey, Drainage District .... County, Kansas

This agreement, made and signed this ..... day of ....., in the year ....., by and between the Board of Supervisors of ..... Drainage District ..... and representing the taxpayers of said district, and hereinafter known as the party of the first part, and ....., a civil engineer of ..... and state of ....., hereinafter known as the party of the second part.

Witnesseth: Said party of the second part in and for the consideration hereinafter mentioned hereby agrees to furnish all professional services, labor and materials, for making a complete and accurate topographical drainage survey and plat of certain lands in said drainage district and in full accordance with the specifications hereinafter mentioned in this agreement.

WORK TO BE DONE

The work contemplated under this contract consists of the field and office work necessary for making a complete and accurate topographical survey and map of lands subject to overflow or subject to direct injury from overflow by excessive water from ..... All such land to be within the boundaries of Drainage District ....., ... County, Kansas. Land which is within the boundaries of the aforesaid district, but which is without question above the flood plane of the above mentioned stream and thereby not subject to direct injury shall not be included within the survey. Where existing ditches, flumes, conduits or other methods of conveying water are adjacent to boundaries of the district, they shall be accurately shown and sufficient data given to compute their capacity.

.....
.....
.....
.....
.....

DETAILED SPECIFICATIONS

1. The general field work may be done with transit and stadia. Stream cross-sections must be taken with the usual engineering leveling instruments.

2. The datum plane used for determining relative elevations may be assumed.

3. Boundaries of the land subject to overflow or subject to direct injury by water from ..... must be determined in the field with reasonable accuracy. Enough data must be included so that such boundaries may be described and accurately platted.

4. Sufficient elevations must be determined so that one-foot interval contours can be plotted with accuracy. The elevations of controlling points such as high or low banks on water courses, beds of bayous, depressions and ridges which cannot be practically shown by contours must be indicated on the drawings by figures.

5. Substantial bench marks shall be established during the progress of the survey, and the distance between adjacent bench marks shall not exceed one-half mile nor shall any point in the district be more than one-half mile from a bench mark. The location, elevation and description of these bench marks shall be shown upon the finished map.

6. Channel cross-sections must be taken of .... at intervals along the channel not exceeding 2000 ft. Channel cross-sections shall be taken at all bridges spanning the above stream.

7. The property and fence lines shall be accurately shown.

8. The names of land owners and number of acres controlled by each owner within the boundaries of this survey shall be determined and shown on the finished map.

9. All public roads, railroads and corporation property shall be shown on the finished map.

10. The meanderings of ..... shall be accurately determined. All minor streams within the

boundaries of this survey shall be shown with reasonable accuracy.

11. The topographical map of the surveyed area shall be neatly and carefully plotted to a scale of 1 in. equals 400 ft. A tracing of this map will be furnished to the party of the first part. The cross-sectional areas of .... shall be plotted on the margins of the finished map to a suitable scale.

12. The party of the second part will be required to turn in to the party of the first part the field books used in making the survey.

13. The traverse line elevations and established bench marks shall be run with an engineer's level. A maximum error of one-tenth of one foot into the square root of the distance in miles will be allowed.

14. The border line of timber areas shall be shown with reasonable accuracy upon the finished plat.

15. All or any portion of a village or incorporated city included within this district shall be shown by streets, blocks and lots upon the finished map.

16. All public roads, school buildings, farm buildings, cemeteries, railroads and corporation property, shall be properly located and shown on the finished map.

17. Maximum high-water marks shall be determined at controlling points in the stream valleys. Maximum high-water marks shall also be shown as near as possible to channel cross-sections herein specified. The locations and elevations of these high-water marks shall be shown in the finished map.

18. In cases of dispute relative to details to be included in the survey and the methods of the work, the same shall be referred to ....., Drainage Engineer, Kansas State Agricultural College, Manhattan, Kan., and his findings shall be final and conclusive.

19. The final acceptance of the survey shall be subject to the approval of the said drainage engineer. In approving the work the said drainage engineer shall have free access to all field books, maps, computations, sketches, or other data acquired by the party of the second part in carrying out the provisions of the contract.

20. The party of the first part assumes no risk nor is responsible in any way for damages resulting from the carrying out of the provisions of this contract.

21. All work not herein specified but which is ordinarily included in a topographical survey of this nature shall be done by the party of the second part without extra charge.

EXECUTION OF CONTRACT

The work shall begin ten (10) days after the signing of this contract and the same shall be completed according to the provisions of the specifications on or before ....., 191...

UNIT PRICE OF WORK

It is further agreed that in consideration for the completion of the work as hereinbefore specified and described in this contract, the party of the first part agrees to pay the party of the second part ..... cents (.....c.) per acre for each and every acre included within the surveyed and platted topographical area.

PAYMENTS

Upon the completion of the survey as specified and the approval of said survey and map as hereinbefore specified, the party of the first part shall within ten (10) days after the acceptance of the map by the said Drainage Engineer, pay to the party of the second part the full and complete compensation for said survey.

In testimony whereof the parties to this agreement have hereunto set their hands the day and year first above written.

.....

[Seal] .....

.....

(Board of Supervisors, ... County, Kansas, Party of the First Part.)

.....

(Civil Engineer: Party of the second part.)

St. Paul Curtails Public Work

Sir—Referring to your editorial of Nov. 15, p. 908, on "Engineering Advice Should Guide Next Season's Municipal Work," I am glad to say that St. Paul has fallen into line by postponing almost a million dollars' worth of local improvement work. This is due directly to the recommendation of the city's chief engineer, Oscar Claussen, that local improvements ordered or pending on order be again called to the attention of property owners, before the work is let or started by the city, with revised estimates showing the cost of the work according to the best information now available on the labor and material situation, in order to obtain the property owners' present views.

During the past month the council, of which M. N. Goss, commissioner of public works, is a member, postponed ten paving projects totaling $431,000, four sewer projects totaling $389,000, and one ornamental lighting system estimated at $105,000. The largest paving project was Raymond Ave., from University Ave. to Dudley St., $114,000. The largest sewer project was Kitsondale Relief Sewer, $371,150. The ornamental lighting system was for 4½ miles of five-light clusters from the Minneapolis city limits along University Ave. to the present downtown lighting system of St. Paul—a fine civic project and desirable, but not a necessity.

Paving work this season has been delayed and in fact postponed, due to the inability of the street railway company to secure track material for relaying their tracks before the street is paved. Two large jobs postponed in this manner are Grand Ave., Milton to Cretin, 2¾ miles, estimated at $125,000, and Concord, from Ada to Annapolis St., estimated at $49,000. This work will be done next year if the company can get rails, but otherwise not, although the work is ordered and the money available.

One of the largest sewer projects ever before the city has been under consideration for the past two years. This is the St. Anthony Hill Relief Sewer, estimated in September, 1916, to cost $797,000, an important sewer project for a rapidly growing residence district. The increased paving area and other permanent improvements have so changed conditions in the district that the present sewer system is now inadequate to take care of the drainage, and storm water backs up in many houses. About 9000 pieces of property are involved in the assessment for this system, and at the hearing in

1916 the council, because of the tremendous protest put up, refused to order the system in, although urged to do so by Commissioner Goss and Chief Engineer Claussen. This protest was due largely to misconception, ignorance of charter provisions, and the absence of a campaign of education, which is necessary before people can understand why, as cities grow, these additional sewers must be provided. The protesters also insisted that a bond issue be floated to pay for the sewer, which was the former method in St. Paul, while the 1914 charter provides that all sewer costs must be assessed against the property benefited. The council postponed the hearing for a year and it came up again last week. The estimated cost is now $1,136,000, due to increased costs of labor and material, and, though the project was again urged by both the chief engineer and the commissioner of public works as being necessary from a sanitary standpoint, the council again refused to order the work done, on account of war conditions.

On local improvement work which is being offered to contractors now and for the past two months, they have refused to bid except on the most select work, and here have bid high. Their attitude is that they do not know what conditions will be next year and they prefer to take chances on losing their organization and having no work to start on in the spring, rather than to go against these uncertain conditions. The appended letter indicates how the situation developed as much as two months ago.

GEORGE H. HERROLD,
St. Paul, Minn. Assistant City Engineer.

CHIEF ENGINEER'S RECOMMENDATION CONCERNING ABSENCE OF BIDS

St. Paul, Minn., Oct. 16, 1917.

Mr. M. N. Goss,
Commissioner of Public Works.

Dear Sir:

With reference to bids submitted on Oct. 15 for various classes of assessment work, you will notice that there were nine jobs on which we did not receive any bids. I therefore recommend that on all jobs that have been advertised from four to seven times the advertising be discontinued and laid over until next spring, when conditions may be such that contractors will appear more inclined to bid.

If any of the parties interested in this work appear at the office, I would recommend that they be told of the existing conditions and be asked to induce some contractor to put in a bid at a certain price, and if the interested property holders are satisfied with this price, we would then advertise the particular job as required by the charter, and award it at the price given.

O. CLAUSSEN,
Chief Engineer.

Twisting Munition Steel Bars Tests Them for Reinforcement

Sir—In the article in your issue of Nov. 15, p. 927, describing a reservoir for the City of St. Paul, I was interested in noting that the use of twisted steel bars for reinforcement was not permitted.

I have no desire to start a riotous debate on the merits of plain, twisted or deformed bars, as I believe enough has been said on this subject in the engineering press in the past few years.

There is one feature, however, I believe worthy of note, and it is a point which we have considered of vital importance in the construction of the works for the Greater Winnipeg Water District; and that is, that the twisted-steel reinforcement has considerable virtue by reason of the fact that each and every bar is subject to a test in the twisting operation. This is of the utmost importance in these days when the quality of steel as obtained from the mills varies from time to time, due to the requirements of munitions manufacture.

We have found that in order to get deliveries in sufficient quantities to keep pace with the work, it is necessary to accept steel which has been rolled for munition work. This not only furnishes a product of a highly desirable quality for reinforcement, but it is a step in the conservation movement, so necessary these days. Munition steel, being a high carbon product, is given a rigid test in the operation of twisting; consequently, we have the assurance that every bar that goes into the work contains no flaws or defects.

Be it said to the credit of the steel manufacturers and the quality of their product never has better steel been produced nor fewer rejections made, even under the severe test of twisting, than has been the case with this high-carbon steel. Of the thousands of twisted bars bent to various shapes for our work there have been fewer breakages than with the former mild-steel bars.

When it is considered that in the design of reinforced-concrete work the stress in the steel is kept at much lower values than would injure the bond of even plain bars, particularly in structures bearing virtually static loads, it would appear that the virtues of twisted bars should bear considerable weight in the mind of the designer, if for no other reason than that of the valuable individual tests given to the bars in the operation of twisting.

M. V. SAUER,
Engineer of Design, Greater Winnipeg Water District.
Winnipeg, Man., Canada.

Variations in Transit Needles

Sir—I have a Gurley light mountain transit and three needles for it. I set this instrument up, carefully set the needle with a magnifier so that it was on an even division of the compass circle and then set a mark. I then tried another needle and found that they differed on the meridian by 30′. I tried the third needle and found that it differed 55′. I did the same using each of the three pins and found the same result, each needle settling very nicely to its own meridian. All the needles were in first-class condition, and so were the pins. I then set up in the same place and sighted on the same successively with a Brandis instrument, one made by Berger, and one by Keuffel & Esser, and found that they all differed from one another, the differences varying from 15′ to 1° 15′. All these instruments were in good condition in every way, as far as I could see. I have long been aware that needles differed, but hardly thought the differences would be so large. I had no extra pins or needles for any of the instruments except the Gurley, but the differences between two of the others exceeded the differences given above. I would like to hear some of your readers' experiences.

W. NEWBROUGH.
Kemmerer, Wyo.

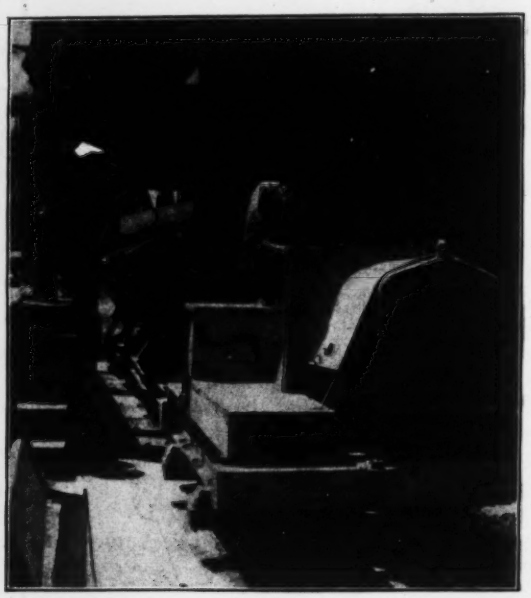
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Auto Engines in Home-Made Dinkeys Saved Money on a Rush Job

IN PLACING the 135,000 cu.yd. of concrete, which is a feature of the work being done this year on rush schedule at Huntington Lake, California, it was decided to use gasoline engines for hauling cars of concrete from the mixer to forms.

First attempts were made with a type of gasoline engine supplied by the maker already mounted on 24-in.



FORD ENGINE ON HOME-MADE TRUCK HANDLING CONCRETE TRAIN

gage truck. The next step was the purchase of a second-hand Overland automobile engine mounted on a homemade truck for industrial service, and, finally, the experiment of adapting Ford automobile engines to home-made trucks was tried and found to be by far the most satisfactory method, besides being cheaper in first cost as well as cost of operation per yard of concrete handled.

The Ford engine is used complete as it comes from the factory as far as the main driving shaft. This is geared directly to a transverse shaft carrying sprockets with chains running to front and rear axles of the car. The relative sprocket diameters are such that the truck runs normally in high gear, making about eight miles per hour on level track without load.

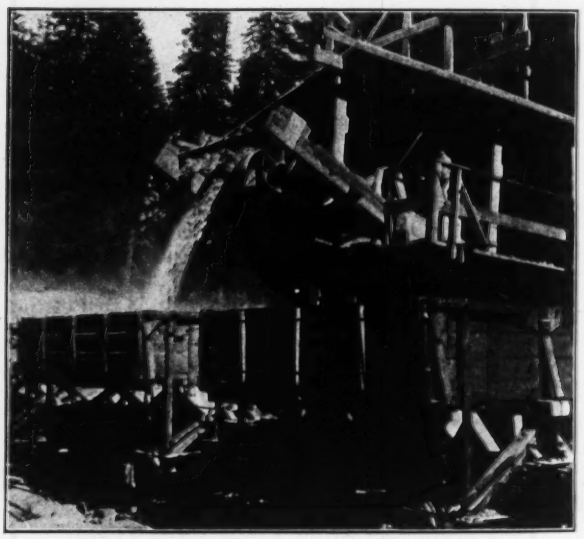
The engine is mounted on a track built up in the company's shops from standard parts, the frame being made up of 8-in. longitudinal I-beams with suitable bracing. Wheels are 12 in. in diameter, of the ordinary pressed steel type used on industrial tracks. The driving sprockets are inside these beams, so that no moving parts project. A 10-gal. gasoline tank mounted above the deck of the truck is housed over to constitute a seat for the driver. Wood buffers are provided at front and rear equipped with coupling connections to suit the ½-yd. Koppel cars which the truck ordinarily operates.

The advantages of a four-cylinder, 22-hp. engine make the Ford trucks far more satisfactory than the one-cylinder, 8-hp. engine first tried, although the latter cost considerably more. The Overland car which was tried out had ample power but was found to be more expensive to operate in this service and the mechanical arrangement of chain drive, etc., was found to be more troublesome. The Ford trucks were built up at a total cost of about $600 each. Two are now in service and two more are under construction.

A general description of the work of raising the three dams on Huntington Lake, which is under the direction of R. C. Starr, hydraulic engineer of the Southern California Edison Co., appeared in *Engineering News-Record* of Dec. 6, p. 1044.

Mixing Sand and Gravel Before They Go to the Mixer

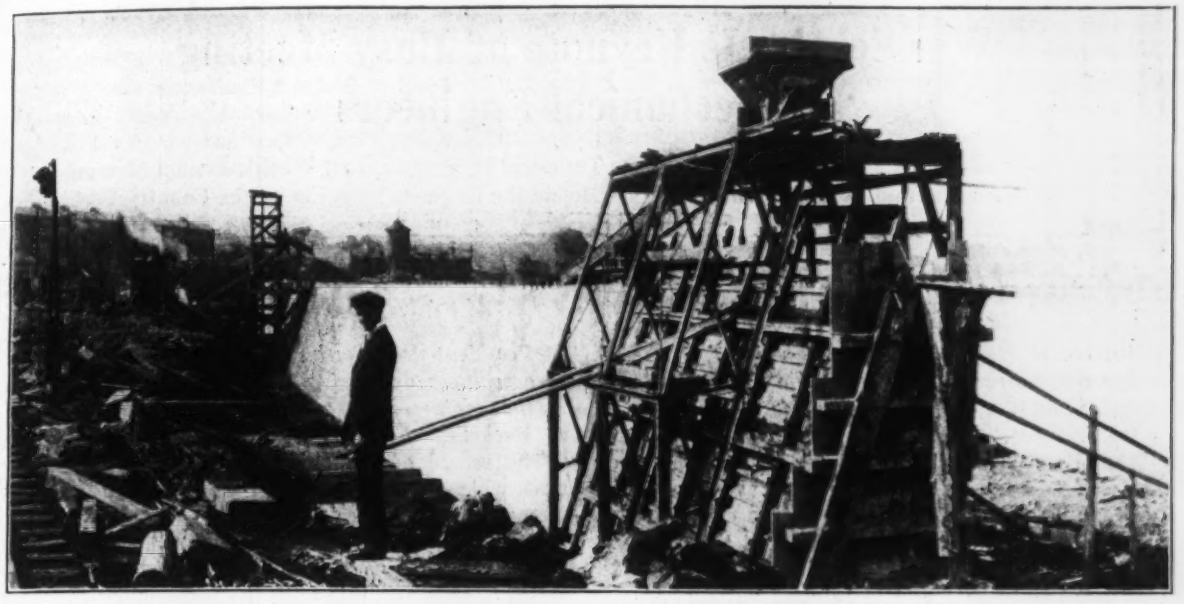
IN INSTALLING the construction equipment for raising the three dams on Huntington Lake, California, which work was described in our last week's issue, a rock-crushing plant with a bunker capacity of 500 cu.yd. was built. Because of the location of the quarry and the



BELT CONVEYOR ELEVATES AND MIXES SAND AND GRAVEL

desired bunker capacity, it was necessary to make the structure 125 ft. high, and it was not desired to add to this the 12 ft. more which would have been required if materials were to be delivered by gravity to cars at surface level.

In order to keep the tracks at grade without increas-



CAR RUNS FROM PLANT AT LEFT ALONG TOP OF WALL TO INCLINE OVER FORM

ing the height of the bunkers, it was decided to deliver the materials from the bunkers onto a belt conveyor which would lift the materials and deliver them into cars on surface tracks. A 8-in. rubber belt conveyor, 30 in. wide and 54 ft. long was then installed.

Two men attend to the loading of materials. One, stationed at the lower end of the belt, controls the doors from the bunkers, and the other, at the upper end, controls the direction of the stream into the cars by means of the deflector valve over the end of the belt, as shown in the accompanying view. He also signals the operator beneath the bunkers when the blow is to be cut off, and directs the "spotting" of the cars.

To economize time a compressed air winch is installed near the bunker siding to shunt the cars as they are filled. Thus the steam locomotive has only to uncouple from the string of empties it brings in, and couple up to the waiting train of loaded cars.

Measuring boxes in the bottoms of the hoppers were originally used in determining the proportion of sand and crushed rock, but after the operators became familiar with the proportion measurement was discontinued and the operator simply adjusted the gates in sand and crushed rock bunkers.

Shuttle Car Carries Concrete to Forms

CONCRETE for a harbor wall along the Genesee River at Rochester, N. Y., for the New York Barge Canal, is placed by a dump car running upon the top of the completed portion of the wall. The concrete is made in a stationary plant, and delivered from the mixer to the bucket of an elevator tower at the back of the wall. From the tower it is spouted into a steel dump car running on a track on top of the wall and operated by a small locomotive.

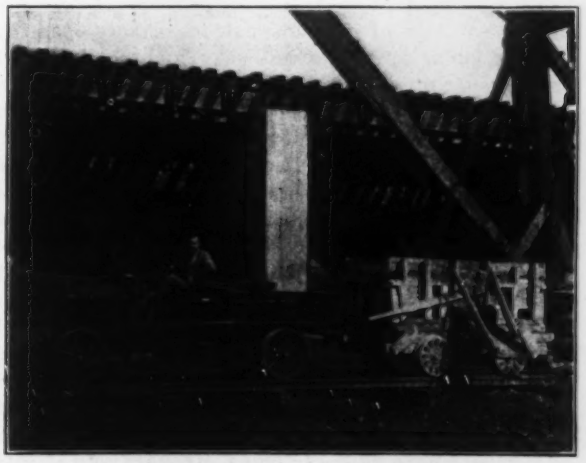
On reaching the section that is being concreted the car is run up an incline to the top of the Blaw steel form, and is there dumped. The car is of the side-dump type but adapted to bottom dumping by cutting a hole in the bottom and fitting this with a cast-iron frame and gate. A wooden frame on top of the car body increases its capacity. With a 1-yd. mixer and car, concrete can be placed at the rate of 20 yd. per hour.

The contractor is M. H. Ripton. The work is under the direction of F. P. Williams, division engineer for the state engineer and surveyor.

Motor Truck on Rails Hauls Concrete Cars

THE ubiquitous Ford seems to relish abuse, as may be seen in the accompanying view where one of the multitude is hauling one yard of concrete on standard-gage railway construction. No essential modification of the car was necessary in this case, the tires simply being removed, and flanges bolted to the rim. The necessary drawbars were bolted to the frame of the the automobile itself, and the arrangement has proved adequate to the task of drawing two yards of dirt.

The modifications are the ideas of John Donovan and W. F. Borden on work being carried on at Pottstown, Penn., for the Philadelphia & Reading Railway.



A NEW USE FOR AN OLD MACHINE

War Service Is Keynote of Busy Meeting of Mechanical Engineers

"Keynote Session" Takes Precedence Over Large Technical Program at Last Week's Annual Meeting—Extracts from Principal War Addresses Define the Engineer's Service to the Country

Service to the Public Is the Essence of Engineering Society Life

Dr. Ira N. Hollis, the retiring president, in the keynote address "Universal Public Service in Peace and War," defined the part which the engineering society should play.

What does our society stand for in the scheme of this world's affairs? As the years have passed, we have come nearer and nearer to a true conception of what our public relations should be, and this war has brought about a sudden large vision of our duties. They are not to be found in reforms put forward by the weak, or by self-seeking manipulators of public opinion, either within or without our society, but rather through a state of mind. We owe it to our country to think clearly and rightly, and to throw the whole weight of our society into the scale for sound legislation, good government, and public conscience. The engineer's philosophy is shown in his actions rather than in his words, because he has never learned to explain himself. It is expressed in the desire to serve. No profession can claim a higher motive.

The Society's Activities Will Be Devoted to War Purposes

President-elect Charles T. Main, in his speech of acceptance, declared war service to be the duty of the engineer and of the American Society of Mechanical Engineers.

The record of the engineering profession and the work which they have done in the past year is worthy of mention, but I feel that we have hardly begun to bear the full measure of the work which we should do. I trust that we in the next year may do something which is commensurate with the responsibilities of the profession.

This is not a time to discuss future policies, and it would be impossible to do so, owing to the rapidly changing conditions; it would be impossible to predict a policy which would cover the entire year. But there is, however, one ruling and central motive which every member of this society and every citzen of this country should set up, and that motive is the concentration of intellect, strength, resources and life, if necessary, to a satisfactory ending of this great war.

THE country's needs in the war crisis dominated the annual meeting of the American Society of Mechanical Engineers, held last week at New York. The principal sessions were given up to war matters. A series of striking addresses dealt with some of the manifold and vital relations of the engineering profession to war supply requirements. Both the retiring president and the president-elect, Dr. Ira N. Hollis, of Worcester, and Charles T. Main, of Boston, gave official expression to the society's readiness for fullest war service. Portions of their remarks are quoted above.

Though the technical proceedings of the meeting embraced subjects of fundamental importance—as, the formulation of new power test codes, and the discussion of a possible organized effort to bring about the saving of millions of tons of coal per year—yet they were relegated to auxiliary sessions. Of the major sessions, the two held Wednesday, Dec. 5, were given up to the broader war subjects. Some important paragraphs from these addresses are reprinted below. At the Thursday sessions two important special subjects were discussed: The Woman Worker, and Training and Employment for Cripples.

William Howard Taft, former President of the United States, addressed the society on Tuesday evening, in conjunction with the conferring of honorary membership on Major-General George W. Goethals, builder of the Panama Canal. After delivering an appreciation of Goethal's work on the Isthmus, Mr. Taft paid tribute to the engineer's part in the war and voiced a demand for reserving engineering students from immediate fighting-line service to supply the nation's technical reserve. These words of primary importance to the profession are reproduced below. The remainder of his address Mr. Taft devoted to an analysis of the war causes and some of its possible effects.

Speaking with intimate knowledge of the busy and complex developments in the national war organization, Gano Dunn, of the J. G. White Engineering Corporation, reviewed the growth of some important engineering offices at Washington, outside of the Departments: the Naval Consulting Board, the National Research Council, the General Engineering Committee, the War Committee of the Technical Societies, the American Engineering Service Committee, etc. He emphasized the value of a roster of engineers, and indicated that delay in preparing such a list had resulted because several volunteer bodies undertook to prepare it. More perfect coördination of the engineering committees at Washington is in prospect. "Those of us who have felt that, because he was not yet called upon, he was not going to have a place in this great war will soon, and very soon, have a call for everything we can render."

W. P. Kennedy spoke on "Motor Transportation." Leonard Metcalf reviewed the great problem of building the cantonments for the national army. He pointed out that the contractors on this work realized an average

net profit of only 2%, and also called attention to the unsuspected extent of the country's resources in contracting. "There was no difficulty in selecting a hundred or more contracting firms each capable of handling millions of dollars of work in a year." A still-existing need of the war work, he said, is "better coördination of the Government construction program—ways, means, and priority."

The woman worker question was opened by two men who are in close contact with it: John W. Upp, of the General Electric Co., and C. B. Lord, of the Wagner Electric Manufacturing Co. Mr. Upp described results obtained, and some of the necessary elements in training, selection of work, safety provision, and the like. Mr. Lord, on the other hand, spoke of the psychological factors in female shop-work: the influence of monotony, of color and cleanliness, of needless irritation, of woman's greater self-consciousness, etc. Many factory managers followed these speakers and brought forward a large amount of testimony in favor of the high efficiency and wide adaptability of women in the shop. Expressed in its broadest terms by F. E. Blake, of the Union Metallic Cartridge Co., the tendency of the remarks was to the effect that "all operations in the shop that do not require man's strength are handled by women with uniform success," and that "the girls are in the shop to stay."

A significant development of the meeting was the passage of a motion calling for steps to develop means of training mechanics. This followed an urgent appeal by a representative of the Military Engineering Committee for furnishing mechanics able to engage in army repair work. An alarming shortage in repair artificers exists at the moment.

Engineers Must Be Saved for Technical Service To Aid the War

William Howard Taft, former president of the United States, in an impassioned address on the war which now engages the nation's energies, points out the great need for conserving the human resources in engineering.

You engineers, all, constitute one of the two professions that are indispensable to the country in the carrying on of the struggle in which the people of the United States are now about to devote themselves: your and the medical profession. You as the constructors of all the material and all the equipment, of which so much is needed now in modern warfare to make effective the work of our boys at the front, and the medical profession to furnish as far as may be the aid in restoring to the ranks those whom the fortunes of war disable.

We have a conscription law, which is justified on the ground that it was a selective draft. We know that under that law those whose services can be most useful to the country in the trenches will be sent over, and those whose services can be most useful to the country in preparing and in saving men and materials should be retained in those places, so that they might not be wasted in the trenches and elsewhere, in which others could do just as good work as they—others who could not discharge the services required of engineers or physicians. We should all profit by the mistakes which England made in allowing her doctors and her medical students and her engineers and engineering students to go into the ranks and be sacrificed. Because of this England has reduced the supply of those indispensable persons so that she is embarrassed, and greatly embarrassed.

Congress and the Administration should see to it that the medical students and the engineering students should be reserved for the work for which they are particularly fitted; that the engineer students and the medical students should be required to go on and complete their preparation as engineers and physicians, so that they may become engineers and doctors, and may then be gathered into the service.

Military Transportation Today Is an Engineering Problem

The army depends on motor-truck transportation, says Major L. B. Moody. Engineers helped the War Department solve the transportation problem.

When you go into the zone where troops are operating the first assumption is that there is no road; and also that transportation becomes specialized. The Medical Corps do not want their patients handled on the cubic-foot or pound-per-mile basis. Likewise, the engineers have special apparatus, such as portable searchlights and demolition equipment. The Signal Corps has its wireless outfit and equipment for their aëroplane service, etc. The Ordnance Department shares in the motor transportation, as it furnishes all the field guns and the materials known as munitions.

When the question of replacing the horse in this special service came up, it was referred to the Ordnance Department. The great difficulty in replacing the army horse is where you have no road and where you have got to be one hundred per cent. certain that you will get there. If the general supply trains fail on the main roads, the men might go hungry for a day; that is not desirable, but it is possible. But if on the other hand you wish to use a gun for a certain purpose it is of no use to have it arrive the next day, it must be there on time.

As to the volume and the organization you can say that practically every gun handled by the United States army will be handled by motor equipment; and if we get an army approximating those on the other side you will get some idea from the number of guns engaged where this has grown.

From operating the experimental equipment we had, at the middle of April last, we have progressed from one officer in charge, a couple of officers, and a couple of draftsmen and five desks, to the point where we have schools turning out to repair these trucks, 30 to 50 trained officers and several hundred trained men every month. We have the estimated number of men actually building these (not counting those in related industries), and they number about 50,000. The number of officers actually on duty is from 300 to 400, the number of enlisted men running into the thousands, all for repairs only. The cost is in excess of the cost of the Panama Canal.

We are endeavoring in the Department to handle

this problem ourselves, but we would have been nowhere but for the assistance we have gotten. Without the assistance of engineers we would be nowhere.

Airplane Production Problems of Vast Magnitude

The military airplane program is a tremendous undertaking both as to production of the machines and as to providing the manpower. Its magnitude is reflected in the following paragraphs from an address by Prof. W. F. Durand, of Leland Stanford University, on "The Aircraft Problem."

In the three centers of airplane production at the present time—Dayton, Detroit and Buffalo, new factories are either completed or on the point of occupancy aggregating something like 35 to 40 acres of ground area, to say nothing of the gallery space. Early in the next year there will be occupied actively in the production of airplanes something like 50 acres of ground area with their gallery space which did not exist eight months ago. And this is without taking into consideration the automobile factories. Acres upon acres of existing automobile areas are running solely on airplanes and airplane parts. And we may certainly anticipate within a few months that this air-factory capacity will be actively occupied in turning out airplanes at the rate of at least several thousand per month.

The demands for supplies are at the limit of our productive capacity. The demand has been incessant for timber—spruce, spruce, and again spruce. Serious difficulties have been found in the way of supply. Substitution of other woods has been thought of, and while the woods have different characteristics from spruce they yet give effective service. And then there are possibilities in the way of metal substitutes which seem to hold hopeful and interesting possibilities.

One of the questions which presented itself again and again, and aside from the questions of policy or program, and one which is vital to the engineer, is that of standardization—standardization of elements and standardization of type. The standardization of elements, such as screw-threads and fastenings has progressed very satisfactorily. There is to be held soon an International Standardization Congress, and I understand this society will have one of its eminent past-officers at this conference, at which we may anticipate a still further approach toward standardization by way of elements and parts.

Parallel with the tremendous stream of production we must have development, research, investigation and a program which is seeking to contact with the unknown and the new; developing, judging, testing and determining all the technical characteristics and their adaptation to the conditions of active service.

Two or three problems not solved yet are of special importance. One is, supercharging airplane engines, the engine to be supplied with means to promote the maintenance of the power at high altitudes, and not suffer the loss normally attendant upon working in a rarified atmosphere. Another problem is modifying at will the pitch of the airplane propellor. It is of small use if the propellor is to maintain its same pitch in an atmosphere of reduced density; the engine will speed beyond the limit and the rotation speed of the engine will impose a limit upon the power which could be developed. Another is that of the spark plug. It is found that in the higher pressure of aëronautic service the spark plug based on automobile practice rapidly breaks down. The insulating characteristics are lost in one hour, or ten hours.

You are all familiar with the design and development of the so-called Liberty Motor. The first engines as you will remember were built in an astonishingly short period of time: A matter of 28 days from the time two men sat down in a room at the Hotel Willard until a motor was set up, and two days later it was ready for test at Washington. The motor has met and is meeting the full expectation of its designers. It has had, as every design is expected to have, minor difficulties and troubles, but not one of them has been fundamental, and it is now in course of active production, on a large scale.

We were impressed with the serious purpose with which the captains of industry in this field of production are approaching this problem. They realize its magnitude and its importance, and they are approaching it with high purpose and patriotism; and with the presence of such a pervading spirit in the industries of this country, we are going to make good with regard to our program of airplane production.

How the Engineering College Will Adapt Itself to War Needs

Two vital subjects discussed by Charles S. Howe, President of Case School of Applied Science: Holding the students of engineering colleges to complete their studies, and revising the courses to fit students more quickly for war service.

Does the country need engineers in time of war? Have we enough engineers now to supply the need during the war and after the war is over?

It would be needless to mention these questions were it not for the fact that if the present methods are carried out there will be no teaching in engineering colleges after a few months have passed, and the engineering colleges are the only places where systematic education in engineering is given. Engineering instruction is carried on to some extent in some shops, and very efficiently carried on, but there is no systematic attempt made over the entire country to give engineering education in the shop. Hence the colleges of engineering are the institutions to which we must look for engineers in the future if we need them.

The War Department is greatly interested in this question and is now taking steps to provide adequate training for a certain number of engineering students. It looks now as if some method would be adopted at Washington before very long whereby engineering students may go on with their training, just as medical students are now going on with their training.

Another question which has been before us is the question of special training during the war.

I think that all of the colleges have insisted on military drill as part of their training. Nearly all of the

colleges have established some military engineering work. For instance, they have taught the students how to build military bridges; they have taught them how to lay out intrenchments, how to make rapid plans of any regions of country, how to do reconnaissance work; how to make maps which could be used by the army officers, and various other things connected with military engineering.

Work has also been given to some extent in the mechanical and electrical engineering departments. Men have been trained in the application of electricity as necessary in the army. Some of us have gone to the military engineering schools where we have been able to find out just what instruction is given the army men in signalling, for instance, and in the use of searchlights, as well as in military telephony and telegraphy. The Chief of Ordnance has suggested that the colleges give their students in machine design in the future the designing of heavy guns and gun carriages, instead of the ordinary machine design.

Some of our institutions will teach their chemists a great deal about explosives, giving them not only the chemistry of explosives, but the methods of manufacturing the explosives—without actually manufacturing the explosives—and teach them the chemistry of all the ingredients that go into the explosives. Quite a number of professors of colleges of chemistry have visited the explosives factories in order to find out the latest methods in use in the manufacture and handling of explosives, as well as to ascertain the different materials that enter into them.

There is still another important question before the engineering colleges. If they lose all of their men over 21 years of age except the physically unfit, and have left, therefore, only the freshmen and sophomores, the greater part of whom are under twenty-one years of age, is it necessary for them to change, or is it not advisable for them to change, their courses of study in order to fit these men for the actual things they may have to do after they go into the army? It has seemed to some of us as though we ought to do this; that is to say, that if we know our courses in the engineering colleges are to be limited to two years, that we ought materially to change our courses of study during those two years in order to fit the men for some of the engineering work which it would be possible for them to do.

Engineers and the Fuel Problem

Prof. L. P. Breckinridge of Sheffield Scientific School says that fifty million tons of coal must be saved, and engineers must help in bringing about this saving.

The fuel problem, precisely stated, is that the coal-bin of the United States is not full. How much do we need to fill it? One hundred million tons. Can we get it? We will try to produce more coal. We may produce fifty million more than we have ever produced, but we shall have to save another fifty million.

If you will build a coal-bin 1000 ft. on each side, that coal-bin will have to be 4½ miles high to hold the coal which will be and must be mined this year in the United States. It takes a good deal to fill that; but if everybody saves a little coal they will save fifty million tons.

One-third, 35 per cent., of the entire freight hauled by our railroads is coal. We would like to fill the coal-bin but we would like to get rid of the job of hauling it. We need the railroads for other things. Sixty-five per cent. of all the coal produced is used to make steam. That is a good deal of coal, but it shows the desirableness of using economy, of saving a lot of this coal by saving steam, and by saving the power we make for steam.

The fuel administrator has a coal-conservation department, Dr. Noyes, and his activities reach to every state. The Bureau of Mines, augmented by a committee appointed by the four national engineering societies, is acting as technical adviser to this conservation department. The various engineering societies can give much help to this question of conservation in their own locality. They should coöperate with the Fuel Administrator in their particular locality. The United States Chamber of Commerce committee on coal conservation has invited Dr. Hollis to appoint some engineers to sit with them, and so they are helping in that way; and in the State Fuel Administration offices engineers are working to save coal.

War Appeal to Drainage Engineers

It is suggested in the November Bulletin of the Oregon Society of Engineers that members of the society who are familiar with the drainage laws of the state coöperate with the farmers of the state to the extent of giving their time in the preliminary stages of the formation of drainage districts. Formation of such districts is needed to bring much of the Willamette Valley to the highest possible state of productivity, but the preliminary investigation calls for an outlay of capital on the part of a few, which is reconvertible only in the event of the actual organization of the district and the completion of the work. "This seems to be an opportunity," says the Bulletin, "for engineers who for any one of a hundred reasons have not been able to bear arms against our enemy, to engage in the work of increasing the food supply, without a great sacrifice on their part."

It Pays To Keep the Labor You Have

Employers are finding labor harder to get and harder to keep than ever before, and yet before the war the overturn was large, according to figures collected by John Lind, assistant secretary of the National Lumber Manufacturers' Association. In 1913 Henry Ford lost $2,500,000 in hiring, fitting and "firing" 52,445 men, to keep a working force of 13,000 men. The men lost $454,000 in wages. A Pittsburgh corporation with a steady payroll of 16,000 men had a labor overturn in 1916 of 187%. The Rock Island Lines in prosecuting track-elevation work in Chicago last year found it necessary to put 2874 names on the payroll in six months to keep a force of 400 working. (See *Engineering News-Record* of Apr. 26, p. 186.) In the United States shipbuilding yards the labor overturn is 500%, according to Meyer Bloomfield, expert for the U. S. Shipping Board, as given in *The Nation's Business*. Experts estimate that it costs from $40 to $150 to hire, fit and "fire" a workman.

Joint Committee on Concrete Ships Makes Report

Cement Association and Concrete Institute Join in Study of Concrete for Floating Craft and Design Large Barge

FOR some months past a joint committee from the American Concrete Institute and the Portland Cement Association has been working, with consulting engineers and naval architects, upon the problem of the design and construction of the concrete barge or ship. Under date of Nov. 27, the two committees made a report, which is presented in abstract herewith. The personnel of the two committees is as follows: American Concrete Institute, L. C. Wason, C. R. Gow, R. W. Lesley, M. M. Upson, H. C. Turner, Chairman; and Portland Cement Association, Jos. Brobston, F. W. Kelley, W. S. Mallory, S. P. Crapo, Edw. D. Boyer, Chairman. Robert W. Boyd, of New York City, was consulting engineer.

The report notes the existence of several concrete barges and ships but states that information as to these vessels is too meager to be of much assistance to the committee. It concludes that the report, then, had better confine itself to a general statement of the several elements which make up the concrete ship problem and a discussion of the information obtained from the tentative design of a concrete ship. The several points taken up in order are as follows:

Relation Between Carrying Capacity and Displacement—The displacement of a ship is the weight of the water she displaces, and is therefore the sum of the weight of the ship itself and its cargo capacity expressed in tons. The cargo capacity will hereafter be spoken of as the "dead weight."

It is apparent that the efficiency of a ship as a cargo carrier depends upon the relationship between dead weight and displacement. Expressed in terms of per cent., in the average cargo ship built of steel, the dead weight is from 70 to 75% of the displacement—taking into account as weight of ship all spars, fittings, deck houses, anchors and chains, auxiliary engines and tanks, but not boilers, engines or coal. In a wooden ship, the dead weight is from 60 to 65% of the displacement. It is quite evident that from the difference in weight of materials, it will be difficult to design a ship of concrete that will give a relationship between dead weight and displacement approaching that of steel. However, if ships are to be built of concrete for commercial use, the weight of the ship must be such as to provide a reasonable dead weight or cargo capacity for the displacement.

Transverse Strength—The stresses in the transverse members of a ship are, in still water, functions of the draft and the stiffness, and may be computed by mathematical processes, although the computations are long and laborious. When the material is reinforced concrete, the problem becomes much more complicated. Experience has shown, however, that numerous elements other than draft effect the transverse strength of a ship, such as the effect of rolling in a sea way, impact with docks or other ships, and stresses incident to going into dry dock. The transverse members of cargo ships of today are, therefore, not designed to withstand computed stresses, but are designed in accordance with various rules which embody the result of long experience in the construction and use of ships. It should be noted in this connection that granting of insurance depends on compliance with these rules.

Steel ships are of two different types, (a) framed ships, in which transverse ribs or frames are spaced from 18 to 24 in. on centers, the plating being riveted to these ribs without intermediate longitudinal members, excepting in the bottom; and (b) longitudinally framed ships (Isherwood), in which heavy frames are spaced from 10 to 15 ft. on centers, with intermediate longitudinals to which the plating is riveted.

From a comparison with the ordinary steel ship design, it would appear to be not difficult to design transverse members of reinforced concrete of equivalent strength to steel members—the question of strength only being considered.

Longitudinal Strength—A ship must be able to meet conditions which are unlike any to which land structures are subject.

In determining the longitudinal strength of a ship, it is customary to assume two conditions. Under the first condition, the ship is assumed to be suspended between two wave crests—the length between crests being equal to the length of the ship between perpendiculars, the height of the wave being equal to one-twentieth of that length. In this case, the ship as a whole is acting as a simple beam supported at the ends. This condition is termed "sagging." Under the second condition, the ship is assumed to be supported amidships on one crest of the same wave. Under this condition, the ship as a whole acts as a cantilever. This condition is termed "hogging." It is apparent, therefore, that when a ship is riding the waves both the deck and the bottom of the ship will be required to withstand tensile and compressive stresses alternately—the maximum tensile stress following the maximum compressive stress at very short intervals. In a steel ship the entire cross-sectional area of the midship section acts to resist these stresses, taking into account, in determining the moment of inertia, all of the continuous members, such as continuous scantlings and deck side and bottom plates. In the concrete ship, equivalent strength must be provided. In the case of the concrete ship, however, only the steel reinforcement can be relied upon to take tensile stresses. The concrete assisted by the steel will take the compressive stresses.

The effect of the rapid change of the character of the stress in either the deck or the bottom is much more serious in the case of a concrete ship than in the steel ship for the reason that, owing to the low tensile stress of concrete, cracks will occur at the extreme fiber under relatively low tensile stresses in the steel. These cracks, if any, alternately opening and closing, may tend to cause disintegration, with resulting leaks or impairment of the reinforcement.

At the present time, little information is available as to the effect of such reversal of stress, and but little can be hoped for until an actual trial has been made of a concrete ship in a sea.

Elasticity—There is an almost unanimous opinion among naval architects and seafaring men generally that a concrete ship will be so inelastic that she will tear herself to pieces in a sea. While it is doubtless true that in a concrete ship there will not be the same readjustment of stresses as in a steel ship when subject to the action of a heavy sea, experience with reinforced-concrete structures generally has shown that such structures have considerable elasticity and there is ample reason for the hope that reinforced concrete will prove a suitable material for shipbuilding purposes.

Effects of Sea Water on Concrete and Reinforcing Steel—Until very recently, little information has been available as to the effect of sea water on concrete. The recent work of the Bureau of Standards, acting in coöperation with the Portland Cement Association, has thrown considerable light on what may be expected from the action of sea water. The result of their investigation tends to show that inferior concrete or concrete of which the surface skin has been impaired suffers serious disintegration when in contact with sea water. Inasmuch as in most instances the structures examined, which form the basis of the report of the Bureau of Standards, were built without thought as to the action of sea water (it being assumed that there would be no deleterious action) there is every reason to hope that where the effect of sea water is appreciated, and where steps are taken in the way of selected materials and adequate workmanship, assuring a good mix and a satisfactory surface skin, the concrete will not so deteriorate.

With regard to the effect of sea water on the reinforcing steel, there is some question as to whether a thin layer of concrete can be relied upon to protect the steel from corrosion. To provide a thick protective layer of concrete outside of the reinforcing steel is practically out of the question, owing to the large increase in weight. If the reinforcement, therefore, is to be maintained in perfect condition, the steel must be protected by galvanization and by increasing the efficiency of the protective concrete by means of additional care in materials and workmanship and by a surface coating of a waterproofing character.

Relative Cost—Just at the present time, the demand for tonnage is so great that any ship of reasonable capacity that can be used for carrying cargo will prove financially successful. The relative costs of ships of concrete and steel,

or concrete and wood, is not therefore as important a consideration as it will be after the war when conditions again approach the normal. However, it is necessary to have an adequate idea of the probable cost of a concrete ship as well as a comparison with the cost of steel and wooden ships.

Speed of Construction—Speed of construction is of vital importance in the shipbuilding program today owing to the immediate requirement for tonnage. If it shall be found that the concrete ship can be constructed in much less time than a steel or wood ship, this fact will contribute largely to the success of the concrete ship.

After this statement of the problem the committee notes that there is a radical difference between the design of a barge for still-water use and of a barge or ship for ocean trade, due to the serious effect of wave action in the open sea. It assumes that at present the vital need is for an ocean-going vessel and devotes its design study to a boat of that type. The vessel design is a 2000-ton, self-propelled barge of a length of 227½ ft., a beam of 42 ft. and a loaded draft of 18 ft., at which draft it would have a displacement of 3675 tons. This vessel is designed in detail in the report. It is stated that the total cost of hull, exclusive of equipment, would be $126,000, or about $63 per ton of dead weight. Against this the committee assumes that the cost of a similar steel hull would range from $90 to $120 per ton and of a wooden hull $70 to $100.

The report concludes as follows:

The designs of various other types of ship in which reinforced concrete has been proposed, either alone or in combination with structural steel, were examined by your committee.

In some of these designs cellular sides and bottoms are proposed. Although double sides and bottoms in ships have distinct advantages, when the material is concrete, such a design appears out of the question, not only because of the considerable increase in weight, but also because of the added complication to the formwork—already a large item in the cost of a concrete ship.

Designs have been proposed in which structural steel members are used as reinforcement. While such members assist somewhat in maintaining the lines of the ship during the construction of the form work, the added advantages can hardly offset the increased cost due to the fabricated steel work and the inefficient use of the reinforcement.

One design has been proposed in which structural steel members are used to support a shell of reinforced concrete. While the claim is made that a ship can be built of the proposed design with only about one-half the steel used in a steel ship of the same capacity, and at much greater speed of construction, the difficulty of making the two materials act together, thus avoiding cracks, makes the design as proposed of doubtful value.

Your committee feels that it is not its function at this time to prepare any detailed plans for a concrete vessel. It is manifestly impossible to design a type of vessel that will be applicable to all classes of service. A barge for use on the canals of New York would not be an efficient type for use in harbors or on the Ohio or on the Mississippi.

Vessels heretofore built have demonstrated that the small barge for still-water service can be built and successfully operated. The solution of the larger problem of a concrete ship will include the solution of smaller vessel problem, in which questions of strength are not of the same prominence.

Although there are some questions regarding the concrete ship which can only be answered by actual experiment, the studies which your committee has made point to the commercial success of the concrete ship.

Your committee suggests that specifications for a concrete vessel should embody the following principles:

1. Both cement and aggregates should be selected with great care to insure a concrete of maximum efficiency.
2. The concrete should be placed in one continuous operation to insure monolithic construction. The concrete mixture should be such as will develop a crushing strength in excess of 3000 lb. per sq.in. when tested in standard cylinders at 28 days. A concrete consisting of one part portland cement, one part sand and two parts ½-in. aggregate may be expected to give such a concrete. The mixture and workmanship must be such as will assure impermeability.
3. The reinforcing steel should be in the form of deformed bars and should be galvanized.
4. In parts of the vessel where cracks in the concrete would tend to cause leaks, the stress in the steel should be kept low (preferably less than 12,000 lb.).
5. Some form of elastic waterproofing coating should be applied to the hull below the deck.

It is understood that the committee will now proceed to the design of a smaller concrete barge of a type suitable for use in the harbors or in the inland waterways of this country.

California Sewage Plants Are Neglected

SEWAGE-DISPOSAL plants in California are now regularly inspected by the State Department of Health. Recent reports indicate that few plants are doing as good work as they might. According to the department's monthly bulletin the City of Auburn, which has a tank with two flowing-through chambers over a common sludge-digestion chamber designed only for parallel operation, persists, although previously instructed, "in an unusual and erroneous method of operation, namely, passing the sewage into one of the flowing-through channels, down through the sludge-digestion chamber, up through the slot and out of the end of the second flowing-through channel. The tank at Whittier is overworked and requires frequent breaking up of scum. The farm on which the effluent is disposed is neglected, but no nuisance is created. Plans for doubling the present size of the disposal plant required at Anaheim are under way. At Chino a 20-acre sewage farm shows neglect but the newly constructed tank is operating satisfactorily.

A new activated-sludge plant at the Folsom State Prison has recently been put into operation to handle the sewage produced by the 1500 inmates. The type of plant was dictated by the fact that it must be located at the base of a cliff below the administration building. The ordinary objections to cost of power, etc., do not pertain here, as the prison generates its own power on the American River. It is expected that the prisoners will be used to operate the plant. The effluent will be chlorinated before being discharged into the American River, because, 20 miles below, the City of Sacramento gets its water supply from the mingled waters of the American River and the Sacramento River. This installation will take the place of a sewage farm on the hills above the river where the topography was such that it was extremely difficult to hold the sewage. It was continually breaking away and reaching the river in large volumes.

Portable Pine Houses for Army in France

Portable knockdown wood houses, to be erected of standard panels fabricated in this country and used for hospitals and barracks in France by the American forces, will require 300,000,000 ft. of pine lumber, according to the Southern Pine Association. The knockdown portable house of standard-sized units was decided on for use in Europe because of the scarcity of labor. Panels made up in this country can be put together quickly with bolts by the troops when they are received abroad. The lumber mills, which do not employ large carpenter forces, propose to furnish the material only, the panels being built by contractors.

Cleveland Sewage Screen Plans Withdrawn from State Department of Health

City Will Submit Plans for Screens and Activated Sludge and Request Postponement of Latter Until Screens Have Been Operated a Year—Screened Sewage To Be Disinfected During Bathing-Beach Season

IT WAS agreed at a conference held in Cleveland, Nov. 15, that the plans for treating the sewage of a portion of the city by fine screening, which had been before the State Department of Health for some months, should be withdrawn by the city, and that in their place there should be submitted for approval plans for fine screens to be followed by a secondary process—probably activated sludge. It is understood that the screens will be installed at once, and that if after they have been in operation at least a year they have not yielded an effluent satisfactory to the State Department of Health, then a secondary process shall be installed in accordance with detailed plans to be approved by the department.

Exact Terms of Agreement

The terms of the agreement, as stated by Dr. A. W. Freeman, state commissioner of health, in a letter dated Nov. 16, addressed to Alexander Bernstein, director of public service of Cleveland, are as follows:

"On yesterday Mr. Dittoe, chief engineer of this department, and myself conferred with you and your engineering advisers in regard to the proposal of the City of Cleveland to install at the W. 58th St. site a sewage-treatment plant of the fine-screen type, which proposal had been submitted to this department for approval under date of June 2, 1917. It seems desirable to reduce our conclusions to writing in order that there be no future misunderstanding.

"The attitude of this department in the matter was expressed substantially as follows: The pending proposal is defined by your consulting engineer as providing for a degree of modification amounting practically to the removal of 10% of the total suspended solids of the sewage to be treated, with chlorination of the effluent during the bathing period. The point for determination by this department, therefore, has been whether or not this degree of purification should be considered sufficient and as complying with the order of the State Board of Health regarding the pollution of Lake Erie and the conditions of approval of the site at W. 58th St. If the proposed degree of purification should be determined to be satisfactory by the department, we would, of course, leave the details of the method to be used to the determination of the City of Cleveland, specifying only that such method comply with generally understood and accepted engineering principles.

"The proposal under consideration has received the careful and prolonged attention on the part of our engineers which its importance deserves, and the advice of a competent consultant has been obtained. The method proposed, that of fine screening with chlorination during the bathing season, is somewhat novel, and examples of its application to comparable conditions are not readily to be found. Determination of the effect upon the lake of the discharge of an effluent so treated is, therefore, largely a matter of individual judgment, and in our opinion the method proposed would not attain the results specified in the order and conditions previously communicated to you by the State Board of Health.

"Upon presentation of these facts you stated that it is the desire of the City of Cleveland to withdraw the present proposal, and to substitute therefor a new proposal involving the use of fine screens with an additional process for secondary treatment. It is suggested by your consulting engineer that this secondary treatment be by the activated-sludge method. It is understood that you will propose to install screens at once, and to add the secondary treatment process if after at least one year's trial of the screens alone it is found that the effluent from the screens does not satisfactorily meet the requirements laid down by the State Board of Health.

"If this is the intention of the city, this department will expect to receive a request for withdrawal of the present proposal. We further indicate to the city our willingness to approve a proposal along the general lines indicated, provided the city agrees in good faith to install satisfactory secondary treatment, should an investigation to be made by this department, based upon at least one year's operation of the screens disclose, in the opinion of this department, the necessity for such additional treatment. It is understood that studies for secondary treatment are to be made and plans prepared prior to the submission of the proposal suggested by the city, and that this secondary treatment meet the conditions previously laid down by the State Board of Health."

The Case Briefly Reviewed

For several years past, Cleveland has been under orders from the State Board (now department) of Health to stop the pollution of Lake Erie and the Cuyahoga River. The plant at W. 58th St. is one of three proposed by the city to that end. The State Board of Health approved the site in January, 1914, with the condition that the works built there "shall be designed for the clarification and disinfection of the sewage, the dispersion of the effluent without nuisance in Lake Erie and for the disposal of the sludge with a minimum production of odors." The objects to be obtained by the treatment are prevention of contamination of the city water-supply and of bathing beaches; prevention of visible pollution of the lake and bathing beaches by floating and suspended matter, gas-lifted sludge, particles and discoloration; and the prevention of sewage odors.

After the operation of a sewage-testing station in 1913-14 under the direction of R. Winthrop Pratt, consulting engineer, and George B. Gascoigne, it was decided that the choice for the W. 58th St. plant lay be-

tween Imhoff tanks and fine screens of some then undetermined type. More data on screens were deemed advisable. Reinsch-Wurl screens of a nominal daily capacity of 7,500,000 gal. were installed, under contract, by the Sanitation Corporation. Test results were recorded by the city under the direction of Messrs. Pratt and Gascoigne from Mar. 20 to Sept. 10, 1916. The Sanitation Corporation made tests, Oct. 23, 1916, to Feb. 20, 1917. George W. Fuller, as consulting engineer for the city, conducted supplementary tests from Feb. 27 to Mar. 3, and from Mar. 5 to 7, 1917.

In August, 1916, Messrs Pratt and Gascoigne recommended that the city install Imhoff tanks instead of fine screens at the W. 58th St. site and on Oct. 10, 1916, the State Department of Health received for approval plans for coarse screens, grit chambers, Imhoff tanks and disinfection—the latter for summer use. On Nov. 15, 1916, the city withdrew these plans, so they were never acted on by the department.

Early in 1917 Mr. Gascoigne submitted a report to the city, approved by Mr. Pratt, adverse to fine screens. Soon afterward Mr. Bernstein called in George W. Fuller, consulting engineer, New York City, for advice on sewage treatment. His report, dated May 14, 1917, recommending fine screens rather than Imhoff tanks, was abstracted in *Engineering News-Record* of Aug. 16, p. 308, as was also the Gascoigne report just mentioned.

On June 4, 1917, the State Department of Health received from Messrs. Fuller and Gascoigne plans for fine screens, as recommended by Mr. Fuller. These plans provided for treating 127,000,000 gal. of sewage a day by bar screens; 96,000,000 gal. by grit chambers; and 64,000,000 gal. by fine screens and (summer) disinfection, and for the passage into Lake Erie through the existing submerged outfall sewer of 85,000,000 gal. a day, which is the full capacity of the outfall. Excess flows would be discharged through storm overflows.

An exhaustive report on this plan for consideration by the state commissioner of health was made Aug. 11 by W. H. Dittoe, chief engineer of the Ohio State Department of Health. A copy of Mr. Dittoe's report was sent for study and opinion to Earle B. Phelps, professor of chemistry, U. S. Public Health Service, and consulting engineer to the International Joint Commission, under an arrangement made with the surgeon-general for the coöperation of the Public Health Service. Professor Phelps' report was dated Sept. 6. Conferences were held during the summer and fall, and meanwhile Mr. Dittoe and Mr. Fuller both prepared supplementary memoranda.

On Oct. 1 these reports and memoranda were submitted to Dr. Freeman. The final outcome of the various reports and conferences was the understanding reached Nov. 15 and set forth in the letter by Dr. Freeman to Mr. Bernstein, as printed above, that the plans for fine screens alone would be withdrawn and in their place plans submitted for fine screens and a secondary process, probably activated sludge, with a postponment of the installation of the latter until screens had been tried for a year. This agreement does not cover the proposed plans at the E. 140th St. and the Cuyahoga River sites.

Operation of Proposed Bond Issue Plan for State Roads of Illinois

In the accompanying table, arranged by the late Wm. W. Marr, chief highway engineer of Illinois, is shown the operation of the bond issue plan recently passed by the legislature of that state, and which will be submitted to the voters in November, 1918.

Issuance of the bonds will start in the year 1920. At that time, and annually thereafter for five years, there will be put out an issue of $10,000,000 each, making in all the sixty millions. With the aid of Secretary of State Emmerson and his staff, this division has arrived at what it estimates will be a very conservative collection of motor license fees each year. This scale is shown in the first column of the table. These collections are figured up to 1944, by which time at the latest, it is estimated not only can all interest on the bonds be paid, but the aggregate principal retired, as well, thus wiping out the State obligation. Meanwhile, contracts will be awarded in 1920, and as soon as the work can be done, contractors will rush the 4000 miles of modern highway to completion. The table shows clearly the sequence proposed in issuance of the bonds, payment of interest and principal and manner of maturity.

HOW PROPOSED ILLINOIS ROAD BOND PLAN IS EXPECTED TO OPERATE

Year	Estimated Motor Fee Collections	Payment on Principal	Interest	Total Payment Principal and Interest	Available for State Aid Allotments (Including Maintenance)	Outstanding Bonds	First Maturity	Second Maturity	Third Maturity	Fourth Maturity	Fifth Maturity	Sixth Maturity
1920	$4,800,000	$2,400,000	$350,000	$2,750,000	$2,050,000	$10,000,000	$2,400,000					
1921	5,200,000	2,400,000	616,000	3,016,000	2,184,000	17,600,000	400,000	$2,000,000				
1922	5,500,000	2,400,000	882,000	3,282,000	2,218,000	25,200,000	400,000	400,000	$1,600,000			
1923	5,800,000	2,400,000	1,148,000	3,548,000	2,252,000	32,800,000	400,000	400,000	400,000	$1,200,000		
1924	6,000,000	2,400,000	1,414,000	3,814,000	2,186,000	40,000,000	400,000	400,000	400,000	400,000	$800,000	
1925	6,000,000	2,400,000	1,680,000	4,080,000	1,920,000	48,000,000	400,000	400,000	400,000	400,000	400,000	$400,000
1926	6,000,000	2,400,000	1,596,000	3,996,000	2,004,000	45,600,000	400,000	400,000	400,000	400,000	400,000	400,000
1927	6,000,000	2,400,000	1,512,000	3,912,000	2,088,000	43,200,000	400,000	400,000	400,000	400,000	400,000	400,000
1928	6,000,000	2,400,000	1,428,000	3,828,000	2,172,000	40,800,000	400,000	400,000	400,000	400,000	400,000	400,000
1929	6,000,000	2,400,000	1,344,000	3,744,000	2,256,000	38,400,000	400,000	400,000	400,000	400,000	400,000	400,000
1930	6,000,000	2,400,000	1,260,000	3,660,000	2,340,000	36,000,000	400,000	400,000	400,000	400,000	400,000	400,000
1931	6,000,000	2,400,000	1,176,000	3,576,000	2,424,000	33,600,000	400,000	400,000	400,000	400,000	400,000	400,000
1932	6,000,000	2,400,000	1,092,000	3,492,000	2,508,000	31,200,000	400,000	400,000	400,000	400,000	400,000	400,000
1933	6,000,000	2,400,000	1,008,000	3,408,000	2,592,000	28,800,000	400,000	400,000	400,000	400,000	400,000	400,000
1934	6,000,000	2,400,000	924,000	3,324,000	2,676,000	26,400,000	400,000	400,000	400,000	400,000	400,000	400,000
1935	6,000,000	2,400,000	840,000	3,240,000	2,760,000	24,000,000	400,000	400,000	400,000	400,000	400,000	400,000
1936	6,000,000	2,400,000	756,000	3,156,000	2,844,000	21,600,000	400,000	400,000	400,000	400,000	400,000	400,000
1937	6,000,000	2,400,000	672,000	3,072,000	2,928,000	19,200,000	400,000	400,000	400,000	400,000	400,000	400,000
1938	6,000,000	2,400,000	588,000	2,988,000	3,012,000	16,800,000	400,000	400,000	400,000	400,000	400,000	400,000
1939	6,000,000	2,400,000	504,000	2,904,000	3,096,000	14,400,000	400,000	400,000	400,000	400,000	400,000	400,000
1940	6,000,000	2,400,000	420,000	2,820,000	3,180,000	12,000,000		800,000	400,000	400,000	400,000	400,000
1941	6,000,000	2,400,000	336,000	2,736,000	3,264,000	9,600,000			1,200,000	400,000	400,000	400,000
1942	6,000,000	2,400,000	252,000	2,652,000	3,348,000	7,200,000				1,600,000	400,000	400,000
1943	6,000,000	2,400,000	168,000	2,568,000	3,432,000	4,800,000					2,000,000	400,000
1944	6,000,000	2,400,000	84,000	2,484,000	3,516,000	2,400,000						2,400,000
Totals	$147,300,000	$60,000,000	$22,050,000	$82,050,000	$65,250,000		$10,000,000	$10,000,000	$10,000,000	$10,000,000	$10,000,000	$10,000,000

NEWS OF THE WEEK

Damage to Engineering Structures at Halifax Not Yet Known

On account of the severe storm which delayed communication with Halifax, Nova Scotia, following the disastrous explosion of the "Mont Blanc" in its harbor, no news has been received of the nature or extent of damage to engineering structures in the city. The scene of the explosion, which is said to have resulted from the ignition of benzine on a ship carrying 2800 tons of nitro-glycerine and trinitro-toluol, is some distance from the new ocean terminal being constructed by the Canadian Government, which is reported virutally undamaged. As to the effect of the disaster on the two new reinforced-concrete piers at the northern end of the business section of the city, very close to the explosion, nothing has been reported. One report that a considerable quantity of fill, trackage and rolling stock at the site of a new railroad yard north of the city was washed away by tidal waves following the explosion is unconfirmed. It is believed that the dry dock mentioned in earlier dispatches is a small one built a long time ago.

Office of Public Roads Urges Highway Coöperation

The Office of Public Roads and Rural Engineering has sent a letter to state highway departments urging the adoption of a definite policy in good road matters, with a view to eliminating from next year's construction the non-essential roads and obtaining effective guarantees for the construction of those which are essential. In so doing the office is in harmony with the policy adopted at the Richmond meeting of the American Association of State Highway Officials, detailed elsewhere in these pages. The office, however, asks that state highway departments communicate directly with it, whereas the state highway officials requested that the material be cleared through the executive committee of the association.

Specifically, the office proposes the three following lines of procedure and also asks for expressions of opinion thereon:

1. The selective consideration of all of next year's construction jobs in all of the states and the preparation of a program of road work throughout the nation, in which program each construction job would be listed in the order of its economic importance to the particular territory in which it is located and to the nation as a whole. This arrangement, he points out, would permit of the postponement of relatively less urgent undertakings.

2. A coördination of this selective process with the railway and water transportation facilities, with a view to insuring an adequate number of cars and vessels of suitable types, with proper distribution to transport materials for the construction of the approved jobs.

3. A coördination with the materials industries with a view to insuring supplies of materials in adequate amount, distribution and deliveries to permit the construction program to be carried out.

Selected Engineering Students Will Be Exempt from Draft

Special Order Places High Grade Students Selected by Faculty in Class Exempt as Being in Military Service

As forecast in these columns last week, on Dec. 8 the Secretary of War ordered that the following paragraph be added by the Provost Marshal General to Section 151 of the Selective Service Regulations governing the draft:

"Under such regulations as the Chief of Engineers may prescribe, a proportion of the students pursuing an engineering course in one of the approved technical engineering schools listed in the War Department, as named by the school faculty, may enlist in the Enlisted Reserve Corps of the Engineer Department and thereafter, upon presentation by the registrant to his local board of a certificate of enlistment, such certificate shall be filed with the questionnaire and the registrant shall be placed in Class V on the ground that he is in the military service of the United States."

Following the issuance of this order, the Chief of Engineers established certain regulations limiting the exemption privilege to those students to whom the school issues the following certificate, properly attested by the president of the school:

"I hereby certify that ——— is a regular student of the ——— class in good standing, as a candidate for an engineering degree at ——— and that in the judgment of the faculty of this school, based upon his academic record, supplemented by his relations with fellow students and by observation of his instructors, he may fairly be regarded as deserving a place in the first third qualitatively of the young men graduating from this institution during the past ten years."

The Provost Marshal General's regulation means that the selected students are to be permitted to complete their engineering course as exempts, just as though they were in the military service of the United States, but they will not be dressed in uniform nor will they be put under salary as members of the military forces of the United States. They are, however, members of the Enlisted Reserve Corps of the U. S. Engineer Department, and as such are subject to immediate call to the colors at any time. At the completion of their course, they will become subject to the call of the draft and may be detailed to any service in the jurisdiction of the military authorities. It is probable, however, that a number of the graduates will be permitted to enter civilian engineering work necessary for the conduct of the war. All engineering students not included within the groups selected by the faculty are subject to the regular provisions of the draft law.

As at first projected, the exemption was to apply to a flat one-third of all engineering students of draft age; that is, the upper third to be selected by straight scholastic grading. It was pointed out by a number of technical educators, however, that in the first place it is very difficult, as most engineering schools are conducted, to determine a fixed percentage grading of students, because in many schools such a system of marking is not used. It was further pointed out that the constant reduction in the size of the upper classes in the technical schools would very soon lead to the inclusion within the upper third of any one class of a number of decidedly low-grade engineering students who are specifically

Miami Conservancy Contracts Awarded

At a meeting of the board of directors of the Miami Conservancy District, Dayton, Ohio, Dec. 3, it was decided to award to the McWilliams Northern Dredging Co., contract 41, Dayton Local Protection above Island Park, in accordance with the bid of the company of Nov. 15. The company's proposal on this contract was as follows:

Clearing and grubbing, two acres at $175.
Soil stripping, 8000 cu.yd., at $0.40.
Embankment in levees, 58,300 yd., at $0.50.
Cleaning up, lump sum, $500.

All other bids received on Nov. 15 were rejected, and the district will handle the rest of the work with its own forces.

intended to be excluded from exemption by the provisions of the order.

It was to meet this contention that the final part of the Chief of Engineers' ruling was added. Under this ruling each faculty will go back through its record of the past ten years and will endeavor to establish, on the basis of scholastic markings and future professional performance, the grading above which would be classed one-third of the graduates of the school. Having fixed that grading in any way satisfactory to themselves, they will go over the draft-age students in the school and recommend as draft exempts all students who apparently are above that fixed grade. It will be seen that this may include very much more than one-third of the present students, particularly if a number of the students who have already left the college are of the lower grade as far as marks and scholastic performance are concerned.

It is possible, of course, that such a system of determination may include in the draft exempts a smaller numerical proportion than one-third, but in the opinion of the educational advisors to the Chief of Engineers such will not be the fact.

The Chief of Engineers has included in his list of schools every engineering school in the United States giving a degree at the end of at least a four years' course, but he has within his power the exclusion of any school whose exempt students do not appear in future to measure up to a proper standard. It is understood that he will keep a careful watch upon the exemption methods pursued by these various faculties and will either by warning or by exclusion from the list of accredited schools be able to keep control of the management of the exemptions.

General Contractors' Association Holds Annual Dinner

Motion pictures showing the construction of narrow-gage and standard-gage tracks and also of highways behind the French front were shown at the annual dinner of the General Contractors' Association, at the Biltmore Hotel, New York City, on the evening of Dec. 8. Always a purely social function, the dinner and entertainment were interrupted only to propose toasts to the President of the United States and to the members of the organization now in the Army. A considerable sprinkling of uniforms bearing the insignia of the Engineer Corps and the Quartermaster Corps increased the military atmosphere of the gathering. Virtually every member of the association is engaged on emergency construction for the War and Navy Departments.

Oregon Irrigation Congress

The seventh annual convention of the Oregon Irrigation Congress will be be held in Portland, Ore., Jan. 2-5, with Jan. 4 set apart for a joint session at Corvallis, Ore., with the State Drainage Association.

State Highway Officials Take Vigorous Action at Richmond Convention

Men from Forty States Discuss Highway Problems and Federal-Aid Law, and Hear Roy D. Chapin

Forty states were represented through their engineers and highway commissioners at the Richmond, Va., convention of the American Association of State Highway Officials on Tuesday, Wednesday and Thursday of last week. They discussed the place of the highways in war transportation, the construction and maintenance of roads in war times, the interpretation and administration of the Federal-Aid road law, and listened to an encouraging and constructive address by Roy D. Chapin, chairman of the Highways Transport Committee. Despite the rather gloomy outlook for road work, the meeting was decidedly optimistic, the reason being that the officials present were filled with faith in the large function which the highway can play in war transportation. At the close of the session vigorous resolutions were adopted, covering the vital issues raised at the meeting. These will be found at the close of this account.

Principal Actions

The four most important features of the convention can be summarized as follows:

1. The Executive Committee and three additional members of the association were directed to place before the attorney general of the United States and the Secretary of Agriculture the need for a more liberal interpretation of the Federal-Aid road law, to the end that the states in the arid regions may not be deprived of the benefits of the law. In those states the only routes upon which the money can be used are such as are not likely for a considerable period to be used for postal service. Under the present interpretation of the law, therefore, those states cannot take advantage of their Federal-Aid allotment, thus nullifying the law in so far as these states are concerned.

2. A report was adopted in accordance with which the Executive Committee will ask the highway department of each state to furnish it with all information necessary for the formulation of a highway war program. This material when collected will be presented to the Highways Transport Committee and the Priority Board, in order that the necessary authority and railroad cars for carrying out these war projects may be secured.

3. The convention discussed at length the function of roads as a military necessity, furnishing the state highway departments the basis for intelligently judging the relative importance of the roads under their jurisdiction.

4. A committee was authorized for the study of regulatory measures for the operation of motor vehicles on the highways.

At the opening session, the president, G. P. Coleman, state highway engineer of Virginia, called attention to some of the important activities of the year. The executive committee successfully presented to the Secretary of Agriculture the desirability of using convicts on Federal-Aid road work. Later, at the request of the War Department, the association was instrumental in securing from highway engineers and contractors a list of road machinery, tools, teams and their location, accompanied by maps of the states, showing location of quarries, gravel pits and other road materials, together with a statement of the output at each operation. This information has proved of great value to the Government, as is shown by the fact that many public pits and quarries have been taken over by the War Department.

In May the association urged that the War Department permit the use of war prisoners on highway construction and other public works. In the following month the president was in Washington in connection with the Chamberlain-Dent marginal road bill. The measure was not passed but is to come up at this session. In addition, there were numerous conferences with the car service committee of the Council of National Defense and with the Priority Board, in relation to car shortage and its relief, particularly with reference to Priority Order No. 2.

Following the president's address, representatives from various sections of the country recounted briefly the conditions under which their work is being carried on. There was repeated emphasis upon the shortage and inefficiency of labor, which apparently are the most trying of the unfavorable conditions attending highway work.

In the afternoon Charles M. Upham, state highway engineer of Delaware, read a paper on car shortage, and Col. William D. Sohier, chairman of the Massachusetts Highway Commission, a paper on military roads, both of which are reprinted in this issue.

Mr. Chapin's Address

A feature of Monday's sessions was the address of Roy D. Chapin, chairman of the Highways Transport Committee. He sketched the prospective work of this committee in its studies of the use of the highways in general and their use by the Government, and brought good cheer in a direct message from Judge Lovett, of the Priority Board. The judge told Mr. Chapin just before the latter started for Richmond that he should be surprised if on Apr. 1 at the latest he would not be able to wipe out Priority Order No. 2. He had looked, he stated, for opportunity for an early raising of the embargo,

but the coal situation was still so critical that the order could not be abrogated at once. Judge Lovett stated emphatically that he did not consider road-building materials in the same class as musical instruments and theaters, thus intimating that the road materials embargo would be raised sooner than that on materials for pleasure uses.

Mr. Chapin urged the association to appoint a committee to coöperate with the Highways Transport Committee. He referred to the studies which the committee is making of methods of relieving railroad terminal congestion, already reported in *Engineering News-Record*, and closed with the statement that as a result of the present critical transportation situation, the importance of highways will be better understood after the war than ever before.

Federal Aid

The discussion on the Federal-Aid road act was opened by a paper by Logan Waller Page, director of the Office of Public Roads and Rural Engineering, on the first year's experience with the law. The paper will be published in this journal next week.

Following the presentation of the paper, representatives from the far West pointed out that under the present interpretation of the law the states in the arid regions do not take advantage of their allotment. As a result of the discussion, the committee (referred to previously) was authorized to present the case to the Secretary of Agriculture and the Attorney General.

In the discussion Mr. Page made clear one matter that seemed not to be well understood—that after the project agreement is signed, the states are given any reasonable time in which to complete the project. He impressed upon those present that the project agreement is the binding document, and that the preliminary statement is subject to alteration at any time before the project agreement is signed. He said, also, much to the satisfaction of the Western delegates, that the Secretary of Agriculture had been asked to approve the use of a scale of 400 ft. to the inch as well as the present standard of 100 ft. T. H. MacDonald, state highway engineer of Iowa, opened the discussion as to whether the Federal-Aid road law should now be amended. He felt that it should not be, and in that view all of those who spoke to the question agreed.

Thursday was devoted to a discussion of various road topics, including the design and construction of road surfaces, the maintenance of macadam, brick, cement, gravel and earth roads. Some of the papers will be printed in a later issue of this journal.

Business Meeting

At the business meeting it was reported that thirty-eight states directly or through representatives had paid dues last year, twenty states taking state membership.

The dues were raised from $5 to $10 a year for individuals, and from $25 to $50 a year for states.

The election of officers for the ensuing year resulted as follows:

President, W. D. Uhler, Pennsylvania; vice-president, A. R. Hirst, Wisconsin; secretary, Maj. Joseph Hyde Pratt, North Carolina (absent on military service); acting secretary, A. D. Williams, West Virginia; treasurer, Frank F. Rogers, Michigan. Executive committee: One year—Ira R. Browning, Utah, and Col. E. A. Stevens, New Jersey; two years—M. L. Cunningham, Oklahoma; three years—Paul D. Sargent, Maine, and W. S. Keller, Alabama; four years—Charles F. Stern, California; five years—G. F. Coleman, Virginia. The meeting voted to increase the executive committee from five to ten members. With the two hold-over members of the committee, T. H. MacDonald, of Iowa, and H. G. Shirley, Maryland, there is one vacancy, which the executive committee was directed to fill.

Report on Priority Order

Because of their importance there are reprinted here in full the principal resolutions and the report of the committee appointed to consider action with reference to Priority Order No. 2 and the carrying on of road work during the season of 1918. The report of the committee to consider action with reference to the priority order and next season's work was as follows:

"The committee recommends that the work proposed to be done on highways next year, wherever shipment of materials by rail is necessary, be confined as far as possible to the adequate maintenance and construction of important main lines connecting the main centers of population, manufacturing, sources of supply and points of actual military importance.

"That the executive committee request the highway department of each state to furnish to it as promptly as possible the following information:

"A map of the state, showing by colors the location of: First, the main improved roads requiring rail shipments of materials for maintenance; second, the location of the various sections of main roads proposed to be improved during the season of 1918 and for which rail shipments will be required, numbering the same in the order of their importance.

"The state departments shall also furnish a concise statement of the number of cars of material required during each month of the year for the maintenance of the main improved roads indicated on the map. They shall also furnish a statement showing the number of cars of material needed for each section scheduled for improvement and the periods during which they will be required.

"That the executive committee request the coöperation of the Highways Transport Committee of the Council of National Defense in bringing about the modification by the Priority Board of its Order No. 2 at the earliest possible date and the definite release of enough open-top cars to the highway departments of the various states for the maintenance and improvement of the main highways of such states."

Resolutions

The chief resolutions were as follows:

"We believe that while every effort of every industry and occupation must be first directed toward carrying this war to an early and successful end, nevertheless the prosecution of highway work is essential, both as a war measure and as an economic measure and that the adoption by the nation, by the states, or by other municipalities, of a policy of half-hearted prosecution of highway work would be an irreparable blunder. We recommend to the several states, care in the selection of improvements, so that there shall be first improved those roads of the greatest economic value in the present crisis. From developments so far, it seems inevitable that the present means of transportation will become utterly inadequate and must be supplemented by motor transportation over the main arteries, and every step must be taken to put these arteries in condition to take and to withstand this traffic.

"Especially do we commend to all highway officials an intensive program of maintenance. Roads which have been built must be saved, and we trust that the executive committee will use every effort to insure that the national authorities give especial consideration to the movement of all materials to be used in maintenance.

"We recommend that in the present emergency all convicts and other prisoners, the harmlessly insane, war prisoners and alien enemies be used in so far as possible in industry and in road construction, and urge legislation to this end.

"We recommend to all highway departments a campaign of education and publicity so that all the people may be fully informed of the necessity, particularly at this time, of continuing a sane program of road construction and intensified maintenance, and of the important place these matters have in the program of prosecuting the war.

"We reiterate our faith in the Federal-Aid road act, and believe that it has done more for the cause of road improvement than any other one influence has ever done. We do not believe that amendments to it should be urged or made until it has been fully tried out in its present form. We respectfully urge upon the Department of Agriculture a more liberal interpretation of its provisions and that the authority of the district engineers in regard to projects, plans and construction be extended, so that the purposes of the act may be accomplished with the minimum delay.

"We commend the appointment of the Highways Transport Committee by

the National Council of Defense and express our appreciation of the attendance and the address of its chairman, Mr. Roy D. Chapin; and we urge this committee to give immediate consideration to all problems coming up in the present emergency and urge them to give us every help possible in securing for road improvement and maintenance the consideration due these great necessities at this time.

"We call the attention of the executive committee to the fact that road improvement rests in a large measure upon the marketing of state and other municipal bonds, and we suggest that they take such action toward enlarging the salability of such bonds as they may find advisable and necessary.

"We recommend most earnestly uniform legislation regulating motor traffic over public highways in the United States to the end that these highways may be constructed and maintained without unnecessary expense to the public."

Civil Engineers Formally Welcomed to New Home

On Dec. 7 the national societies of mechanical, electrical and mining engineers joined in a formal welcome to the American Society of Civil Engineers, which has recently removed from its former home on Fifty-seventh Street, New York, to new quarters in the Engineering Societies' Building. Charles F. Rand, president of the United Engineering Society, presided.

Gano Dunn, speaking for the American Institute of Electrical Engineers, struck the keynote of the meeting when he said that the union of all the societies under one roof was the symbol of the movement toward unity in the profession which has become general in recent years. He expressed the belief, too, that all of the four national societies could henceforth do greater things because of the strength they would derive from their closer coöperation.

Dr. Ira N. Hollis spoke for the American Society of Mechanical Engineers, emphasizing the responsibility of the engineer for the industrial order of the Twentieth Century and pointing out that it is his task to help make the world safe for democracy, even as his instrumentalities now are adding to the horror of the great war.

Dr. Rossiter W. Raymond represented the American Institute of Mining Engineers, and in a most happy speech gathered unto the mining engineer the glories of all the other branches of the profession, his thesis being that the work of the mining engineer gave to each of the other branches its greatest opportunity for displaying its capacity. Seriously, he saw in the union the consummation of a great project and large opportunities for united action.

William L. Saunders, past president of the American Institute of Mining Engineers, speaking "at large," as the chairman put it, expressed the view that the occasion celebrated not merely a physical union but a spiritual uniting of forces for participation in civic affairs. He related that the district boards for passing upon draft exemptions originally were supposed to have one engineer each, but that when the lists were returned by the governors of the states 90% of the engineers' names had been eliminated. The reason was, he said, that we are not organized for civic service. Real accomplishment in national affairs, he maintained, cannot be expected until we organize on the same basis that our political system is organized—by states, counties, cities and wards.

George H. Pegram, president of the American Society of Civil Engineers, responded on behalf of the civil engineers. He averred that the society moved to the joint house because service to our fellow men, the interests of engineers and of the membership demanded it. The public, in his opinion, had not been informed on the work of the engineer, and not until it is so informed can engineers expect the recognition they deserve. In the closer cooperation of the four great societies he saw an opportunity for placing the engineer in the right position before the public.

Dr. George F. Swain responded to the addresses of welcome on behalf of the members of the American Society of Civil Engineers resident outside of New York. It was his opinion that the society should have been in the union house before, and that it was there now in order that it might pull together with the other societies. In his opinion engineering organizations had heretofore confined themselves to two of four important purposes that they should forward. They have tried to advance engineering knowledge and to erect high standards for professional work and conduct. There remains now the work of making the engineer felt as a member of the community, and of working out plans by which the societies shall do more for the individual member.

Denies Right To Organize Labor for Strike

While Admitting Legality of Unions Supreme Court Rules Coercive Intent Is Unlawful

The Supreme Court ruled on Sept. 10 that while workmen had the legal right to organize for lawful purposes, employers also have the right to operate their plants at any time as "open shops" and in any way to prevent conspiracies which look forward to bringing their nonunion employees into any labor organization. The opinions were rendered in the cases of the Hitchman Coal and Coke Co. and the Eagle Glass Manufacturing Co., of West Virginia, and upheld an injunction issued by Judge A. G. Dayton, which effected a restraint upon the union officials in their attempt to organize the employees of these two companies. Lower courts had held that the United Mine Workers of America and the American Flint Glass Workers' Union were illegal organizations and were, under the Sherman law, indulging in secret conspiracies to restrain trade. However, both of these lower-court rulings were ignored by the Supreme Court. Justices Brandeis, Holmes and Clarke dissented.

In the Hitchman case, the majority of the court held that the officials of the miners' union "deliberately and advisedly selected that method of enlarging the union membership that would inflict injuries upon the company and its loyal employees," and declared that the "conduct in so doing was unlawful and malicious." The court further ruled that it was a mistake to assume that if methods used by unions in their attempt to organize a body of workers were peaceable and stopped short of physical violence they were, therefore, legal. The opinion was in effect a statement that any organization was unlawful which looked forward to precipitating a strike for the purpose of compelling an employer to unionize his mine or shop as the lesser evil. It was held that the plaintiff "was acting within its lawful rights in employing its men upon the terms that they should not be members of the United Mine Workers," and further, that, while this agreement was terminable at the desire of either party, it gave no right to anyone to instigate a strike through an evasion of this agreement.

The contempt proceedings instituted last month by the Hitchman Coal and Coke Co. against Frank J. Hayes, president of the miners' union, and fifteen other officials and members, for alleged violations of the injunctions, are still pending, and, according to the company's counsel, will be pressed. The defendants have been allowed sixty days in which to present their case.

Washington Engineers Dine

The Washington Society of Engineers forestalled possible criticism of its annual dinner this year of economy by having the Food Administrator of the United States at one head table and the Fuel Administrator at another. With the Vice President of the United States present to give official approval to the function and Mr. Hoover and Mr. Garfield to guarantee a proper economy of food, fuel and light, no one present could feel that he was over-indulging, by attendance. Over three hundred of the engineers permanently or temporarily resident at the capital listened with enjoyment to Messrs. Marshall, Hoover and Garfield and to Colonel Martin, of the French Army, a member of his country's military commission here. A. L. Baldwin, president of the society, was toastmaster, and John C. Hoyt was chairman of the committee which arranged the dinner.

Gen. Goethals on Mechanical Engineers at Panama

Acknowledges Election to Honorary Membership in American Society of Mechanical Engineers

Honorary membership in the American Society of Mechanical Engineers was conferred on Maj. Gen. George W. Goethals at a formal meeting held Tuesday evening, Dec. 4. In responding, General Goethals graphically pictured as follows the importance of the mechanical engineer's part in completing the Panama Canal:

'It is generally believed that I built the Panama Canal. That is a mistake. The man who dug it claims to have built it; his successor in office claims to have built it; and I claim to have been one of 50,000 men who built it. I learned exactly where I came in, in a trip that I took across the canal in a Panama R.R. train, when the foreman, describing the canal to a visitor, led the visitor to understand that he was doing pretty much all of it. The visitor finally turned to him and said: 'What is the "Old Man," as you call him, doing?' The foreman replied: 'Oh, he comes around and sees us doing it, jollies us a bit, and then goes back and sits in the office and entertains visitors.'

"Those of you who visited the canal during the construction period must have appreciated the part performed by the mechanical engineers in the constructive machinery that we had for the work, and must have appreciated the mechanical work done in the states in order that we might carry it forward. Those of you who have visited the canal since its completion and have seen the satisfactory working of the machinery of the locks, the dredging equipment used in the removal of the slides, and the various other appliances, must have appreciated the work of the mechanical engineers in the designing and construction of that machinery, and realizing the assistance that they gave in the work, during its constructive period, and appreciating this assistance in its operating period, you may perhaps form some idea of the appreciation I have for the honor that this society has conferred upon me, by electing me an honorary member."

ENGINEERING SOCIETIES

At the annual meeting this evening of the **Engineers' Club of Trenton, N. J.**, Alfred D. Flinn, deputy chief engineer, Board of Water-Supply, New York City, will give an illustrated talk on "New York's Catskill Mountain Water-Supply."

The **Engineers' Club of St. Louis'** nominating committee has placed the following names on the official ticket: C. S. Ruffner, president; B. L. Brown, G. R. Wadleigh and W. E. Rolfe, vice presidents; P. H. Ichlingman, treasurer; C. L. Howkins, C. W. Martin and J. P. Morrison, directors.

The Colorado Association of Members of the American Society of Civil Engineers, at its meeting Dec. 8, listened to an address by J. M. Gaylord, of the United States Reclamation Service, on "Experiences of the United States Reclamation Service with Large Reservoir Outlets." The address dealt with the operation, both successful and otherwise, of various types of reservoir outlets. A general discussion followed the delivery of the address.

The St. Louis Association of Members of the American Society of Civil Engineers at the meeting on Nov. 26 elected the following officers for 1918: J. A. Ockerson, president; E. E. Wall and W. S. Mitchell, vice presidents; C. M. Daily, secretary-treasurer. Capt. A. A. Poland, Quartermaster Corps, U. S. Reserves, told about the efforts being made by the Government to revive river navigation. H. J. Pfeifer, chief engineer, St. Louis Terminal Railroad Association, spoke on the coöperation of the railways with the Government.

The Albany Society of Civil Engineers will hold its annual meeting at Keeler's Hotel, Dec. 18. Prof. Thomas R. Lawson, of the Rensselaer Polytechnic Institute, will deliver a lecture, illustrated by lantern slides, on "Some Steel Structures." The topic will include steel bridges, and especially the recently constructed Congress St. bridge across the Hudson River at Troy. Officers of the society for the ensuing year will be elected at this meeting.

At the December meeting of the **Providence Engineering Society**, to be held Dec. 18, Thomas C. Atwood, U. S. Navy supervising engineer of the U. S. Emergency Destroyer plant, will give an illustrated lecture on "Emergency Ship Construction." At the Dec. 20 meeting of the municipal engineering section of the society, George A. Carpenter, city engineer, Pawtucket, R. I., will deliver a lecture on the "Rate of Precipitation and Notes on Catch-Basin Maintenance." The December meeting of the efficiency section, Dec. 14, will hear a talk on "Time Study and Its Effect Upon the Workman." The speaker will be C. O. Larson, of the Forbes Lithograph Manufacturing Co., Chelsea, Mass. On Jan. 2 "Hard Pine and the Causes of Dry Rot" will be discussed at the meeting of the structural section of the society.

The Engineers' Club of Seattle, Wash., on Nov. 29 gave a special Thanksgiving luncheon and program, at which Dr. Carter Helm Jones, of Seattle, delivered an address on "The Patriotic Engineer."

The Northwest Society of Highway Engineers will hold a special meeting in Salem, Ore., Dec. 15. The program will be opened by an address by Governor Withycombe, and his talk will be followed by a number of technical papers on engineering subjects.

The junior members of the **Engineers' Club of Philadelphia** have organized a section of their own under the supervision of one of the senior members, Dr. W. M. Boehm. A meeting was held on Dec. 11, at which L. M. Goldsmith presented a paper on "The Measurement of the Flow of Liquids and Gases in Pipes." H. I. Goldstein is chairman of the junior section.

The Illinois Society of Engineers will hold its annual convention, Jan. 24-25, at Quincy. E. E. R. Tratman, Wheaton, Ill., is secretary of the society.

The American Association of Engineers has organized a local chapter in New York City, with headquarters at 220 West 42nd St. Temporarily, meetings are held at the Hotel McAlpin, Broadway and 33rd St. These meetings have been devoted mainly to the work of organization, but the chapter announces that it will shortly be in a position to engage in constructive work along the lines followed by the national association. The next meeting will be held Dec. 17. There will be a short talk on "Sub-Aqueous Piledriving," followed by discussion.

The Association of Iron and Steel Electrical Engineers will hold its regular monthly meeting at the Hotel Chatham (old Hotel Lincoln), Pittsburgh, on Dec. 15. A paper on "Flywheels on Steel Mill Motors" will be read by G. E. Stoltz, of the Westinghouse Electric and Manufacturing Co. The Philadelphia section of the association will hold its meeting on Jan. 5, at which Messrs. J. C. Reed and Merwyn J. Hocker, electrical engineers of the Bethlehem Steel Co., Steelton, Penn., will present a paper, illustrated with lantern slides, on "Electrically

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, 29 West 39th St., New York; Jan. 16 and 17, 1918, New York; Charles Warren Hunt, secretary.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, 35 Nassau St., New York; Jan. 14, New York; F. A. Molitor, secretary.

NEW ENGLAND WATER-WORKS ASSOCIATION; 715 Tremont Temple, Boston; Jan. 9, Boston; Willard Kent, secretary.

AMERICAN WOOD PRESERVERS' ASSOCIATION; Baltimore, Md., Jan. 22-24, Chicago; F. I. Angier, Baltimore & Ohio R.R., Mount Royal Station, Baltimore, Md., secretary.

CANADIAN SOCIETY OF CIVIL ENGINEERS; Montreal; Jan. 8, Montreal; Fraser S. Keith, 176 Mansfield St., Montreal, Can., secretary.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS; Dec. 27-29, Chicago; C. K. Shedd, Ames, Ia., secretary.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston; Feb. 7-9, Chicago; H. B. Alvord, secretary.

Operated Bridges." The January meeting of the Pittsburgh section will be a joint meeting with the American Institute of Electrical Engineers. Papers will be presented on "Generation, Distribution and Consumption of Power, as Well as Power Factor Correction."

The **Louisiana Engineering Society** held its regular meeting in New Orleans on Dec. 10. There was an informal talk by First Lieut. Joseph F. Ward, O. R. C., on "His Experience in Training Camp."

PERSONAL NOTES

COL. THOMAS H. REES has been made department engineer for the Territory of Hawaii by the U. S. Engineering Department, according to an announcement recently made in San Francisco. Colonel Rees has served in the Philippines and was for a time ranking officer on rivers and harbor work in the California District.

W. J. HAZELTINE, city engineer of Mansfield, Ohio, resigned Oct. 31 and has accepted a position with the Austin Co., New York.

W. D. LIVESAY, formerly chief engineer on the design of an industrial plant for the Pyrites Company, Ltd., Wilmington, Del., is now assistant bridge engineer with the Seaboard Air Lines Railway Co., with office at Norfolk, Virginia.

GEORGE R. HALPIN, for two years superintendent of the water board of Watervliet, N. Y., has resigned to take a position at the Government arsenal at Watervliet.

HOWARD J. TEAS, formerly junior highway engineer on the East St. Louis Division of the Illinois Highway Department, has been transferred from the 23rd Engineers (Highway Regiment) to the 27th Engineers (Mining Regiment).

W. A. SWALLOW, formerly chief engineer of the Georgia & Florida Ry., at Augusta, Ga., is now captain in the Quartermaster Reserve Corps and has been transferred from Greenville, S. C., to Norfolk, Va., as assistant constructing quartermaster on Pig Point Ordnance Depot.

C. R. BRECK, JR., district engineer at Matanuska, recently left Alaska for his home at Berkeley, Calif. He entered the employ of the Alaska Engineering Commission in 1914. It is his intention to offer his services to the Government for duty with one of the railroad regiments at the front, after a short rest at his home.

EDWARD C. THOMES has resigned his position as city engineer of the City of Poplar Bluff, Mo., and is now a drainage engineer, in the Office of Drainage Investigations, Department of Agriculture, Washington, D. C.

New Chief Engineer of the Erie

GALEN R. OWEN

J. B. CLINGMAN, formerly road engineer of Madison County, North Carolina, has been appointed supervisor of road maintenance for the western district of North Carolina, with headquarters at Asheville.

T. L. WOLFE, sanitary engineer of the J. B. McCrary Co., Atlanta, Ga., has been appointed captain in the Engineer Officers' Reserve Corps.

CALVIN W. HENDRICK, formerly chief engineer of the City of Baltimore and chief engineer of the Sewerage Commission of Baltimore, has been elected president of the West Virginia Coal and Timber Co., organized to develop a tract of 32,000 acres of coal and timber lands in West Virginia. Mr. Hendrick has also been elected president of the American Train Control Co. His headquarters will be in Baltimore.

HOWARD T. VARE, formerly with James Stewart & Co., New York, and V. E. Ware, El Paso, Tex., is now a sergeant in Bakery Co. No. 4, Fort Sam Houston, San Antonio, Texas.

R. C. KELLOGG, formerly with E. W. Bemis, consulting engineer, is now special assistant gas engineer for the Illinois Public Utilities Commission and consulting gas engineer for the Director Iron Co., Chicago.

J. J. JESSUP, for 17 years connected with the engineering department of the City of Berkeley, Calif., has resigned the position of city engineer and superintendent of streets to engage in private practice. In 1900 Mr. Jessup left the position of instructor of engineering at the University of California to become assistant city engineer and nine years later was made city engineer. He has been succeeded by CLYDE C. KENNEDY, his former assistant.

WARREN W. INGLIS has resigned as engineer for the Benson Mines Co., Benson Mines, N. Y., and the Northern Ore Co., Edwards, N. Y., to accept a position in the building division, engineering department of the American Brass Co., Waterbury, New York.

S. LELAND TOLMAN, sanitary engineer, has left the employ of the Casper-Ranger Construction Co., of Holyoke, Mass., and is now superintendent of a new sewage-disposal plant and garbage incinerator, Mason City, Iowa.

R. L. LONGSHORE, formerly deputy county engineer of Adams County, Indiana, is now assistant engineer, maintenance-of-way, Detroit Division of the Wabash Ry., at Montpelier, Ohio.

C. G. YOUNG has entered the organization of Ford, Bacon & Davis, New York. Mr. Young will be particularly engaged on reports and appraisals of public-utility and industrial properties.

W. R. HARRIS, formerly managing director of the Canadian Lock Joint Pipe Co., Ltd., and president of the Harris Engineering Co., Ltd., Regina, Canada, is now engineer of the Cement Products Bureau, Portland Cement Association, Chicago.

D. R. THORNTON, who was with the New York State Highway Department at Watertown, N. Y., for nine years, is now engaged in dock work for the City of Beaumont, Texas.

W. J. MAUER, until recently engineer in charge of the Chicago Commission on Ventilation, is now connected with the American Radiator Company.

FRANK S. PECK has resigned as county engineer of Lawrence, S. D., and is now highway engineer for the State of South Dakota.

DR. THOMAS G. DARLINGTON, former Health Commissioner of New York City, has been retained by the American International Shipbuilding Corporation to have direction of the sanitation at Hog Island, near Philadelphia.

P. S. GARDINER, vice president of the Southern Pine Association and secretary of the Eastman-Gardiner Lumber Co., Laurel, Miss., has been called to go to France on special service connected with the war work of the Young Men's Christian Association.

HENRY W. HODGE, former Public Service Commissioner of the First District of the State of New York, now serving with General Pershing, has been promoted to the rank of lieutenant colonel.

HERBERT H. SUTTON has been appointed chief engineer for the State Fire Insurance Commission of Texas. For the past three years Mr. Sutton has

been electrical engineer for the commission, and his place as such has been filled by A. M. VAUGHN, of San Antonio, who has been connected with the commission several years.

BENJAMIN BROOKS, recently engineer for the International Clay Products Bureau, is now Major Brooks, of the National Army.

H. V. DICKINSON, formerly assistant to the chief engineer of the Palisades Interstate Park, is now a sergeant in the 23rd Engineers, at Camp Meade, Maryland.

FRANK HELM, who was division engineer of the Santa Fé Railway Co., at Slaton, Tex., has been promoted to office engineer at Topeka on the Eastern Lines.

R. J. TORRALBAS, formerly employed in the city engineer's office, Havana, Cuba, is now assistant general manager of the Santa Lucia Sugar Co., Oriente, Cuba.

HERBERT J. GILKEY, formerly with the Pennsylvania R.R. on track-elevation work at Chicago, is now a first lieutenant in the Engineer Officers' Reserve Corps, and has been assigned to military mapping work along the border, under the Director of the United States Geological Survey.

R. HAYES, until recently resident engineer of the Southern Railway System, at Hayne, S. C., is now structural engineer, with headquarters in Washington, D. C., succeeding P. B. LUM, who resigned and is now with the Auto Car Sales and Service Co., Washington, District of Columbia.

OBITUARY

WILLIAM KELLY, 67 years old, of Brooklyn, N. Y., a contractor who did much of the paving of Brooklyn and Manhattan streets with granite blocks and asphalt, died in Brooklyn, Nov. 28.

TRADE PUBLICATIONS

The Blaw-Knox Co., Pittsburgh, is sending out a folder on its locking cableway carriages.

The W. B. Louer Co., 415 South Dearborn St., Chicago, Ill., has issued a new edition of its Red Book, containing list of machinery and supplies for contractors, bridge builders, railroads, etc.

The Link-Belt silent chain, as applied to a clay-working plant, is described in a new bulletin issued by the Link-Belt Co., Chicago, Ill., entitled "The Ideal Drive for Clay-Working Machinery."

Walter A. Zelnicker Supply Co., St. Louis, is sending out Bulletin No. 227, intended for buyers of rails, cars, locomotives, cranes, tanks, compressors, boilers, hoists, etc.

Automatic pumps and receivers are described in Bulletin D-1301, issued by the Worthington Pump and Machinery Corporation, 115 Broadway, New York.

The E. I. du Pont de Nemours Co., Wilmington, Del., has issued another edition of the Du Pont Products Book, which, in addition to the various explosives made by this company, describes Fabrikoid, a leather substitute, Py-ra-lin, chemicals and paints made by its subsidiaries.

The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has issued Catalog No. 30 describing industrial motors.

BUSINESS NEWS

Dr. Edward Ewing Pratt, until recently chief of the Bureau of Foreign and Domestic Commerce, Washington, D. C., has been elected to the office of vice president of the Pacific Commercial Co., 11 Broadway, New York.

The C. D. Pruden Co., manufacturer of "Prudential" portable galvanized steel buildings, underwriters' hollow metal windows and other equipment, Baltimore, Md., on Dec. 1 opened a general sales office at 56-58 Pine St., New York. The office is in charge of Leigh Pruden, vice president of the company.

The Terwilliger Equipment Co., until recently at 314 Bulletin Building, Philadelphia, has been incorporated and has removed to 2013 Market St., where it has increased office facilities and also a warehouse for the display of motor trucks, concrete mixers, trailers, tractors, etc. The personnel of the company is as follows: President, E. M. Terwilliger, formerly Philadelphia manager for the Austin-Western Road Machinery Co.; vice president, H. E. Green, formerly district manager for the Browning Crane Co.; secretary, John A. Conboy, for several years in charge of the concrete mixer department of the Standard Supply and Equipment Co.; treasurer, W. George Brooks, until recently sales manager of the Packard Motor Co., Philadelphia.

L. B. Moses, who has been associated with the rail trade since 1903, when he left the position of assistant to the president of the Kansas City Southern Ry., is now connected with Walter A. Zelnicker Supply Co., St. Louis. Since 1911 Mr. Moses has been sales manager of the Kettle River Co., of Minneapolis. He has joined the Zelnicker organization as second vice president in charge of the rail department, with headquarters in St. Louis.

John D. Westbrook, Inc., Norfolk, Va., has been added to the selling force of the Pulsometer Steam Pump Co., Irvington, New Jersey.

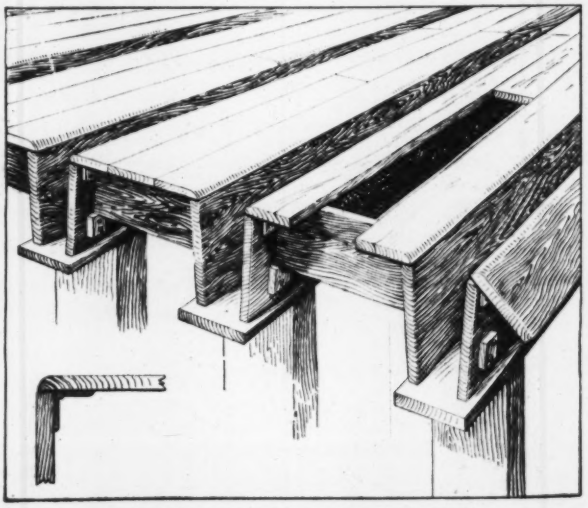
George A. Caldwell, Boston, Mass., and Walter N. Fairfield, Hartford, Conn., formerly connected with the H. Mueller Manufacturing Co., have formed the firm of Caldwell & Fairfield, manufacturers' agents, selling water-works goods in the New England States. They will represent the United Brass Manufacturing Co., of Cleveland, Ohio, manufacturer of brass goods for water, steam and gas, and will also sell Buffalo service and valve boxes, manufactured by Bingham & Taylor, Buffalo, New York.

The Austin Co., Cleveland, Ohio, announces that E. M. Haas has become connected with the company and will represent it in the railroad field. Mr. Haas was recently sales manager of the International Steel Tie Co. and until a year ago was Western editor of the *Electric Railway Journal*.

APPLIANCES AND MATERIALS

Collapsible Wood-Joist Forms for Concrete Beams

The Collapsible Joist Form Co., of Kansas City, Mo., has put on the market a wood form for concrete beams and girders which is hinged so as to be readily collapsible and used over again. It comprises beam sides, hinged to a short width of slab bottom form and provided with cleats on which span short joist which hold the middle section of the slab-bottom form. The detail and operation of the form may be noted from the accompanying view.



COLLAPSIBLE WOOD FORMS CAN BE USED MANY TIMES